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Self-Depreciation—and the Penalty.

SOMETIMES American visitors, observing at close quarters our attitude towards our industrial and other problems, venture the friendly criticism that we are prone to be self-critical and self-depreciatory, while they, on their side, living in a land overflowing with milk and money, are inclined to be over-confident and self-congratulatory.

Occasionally when we are inclined to brush depressing signs aside and adopt a thorough-going optimism, we are warned by some of our own critics of the folly of shutting our eyes to the incontrovertible facts, or hiding our heads in the sand.

Both kinds of criticism are useful if they lead to absence of panic, sane thinking, and reasonable action. But in addition to these two views, there is another to which we need to pay greater heed under certain circumstances; we refer to the observations of the Britisher abroad. Our business men who are operating in colonial and foreign markets on our behalf are able to judge at close quarters the effect of our self-criticism and depression upon the minds of other people. These business men are face to face with actual trading difficulties, and if British spokesmen and newspapers represent us as industrially on the down grade, overdoing it so as to indicate that unless this or that happens we shall soon be at the end of things, those difficulties will grow worse.

The *Journal* of the British Chamber of Commerce in the United States has uttered a protest against "Too much cabled pessimism." Englishmen in the States find that too much stress is being laid on unfavourable industrial conditions in Great Britain. Whether the Press reports that they have in mind be true or false, whether justifiable or otherwise regarded in the light of the facts, the publication of our troubles does not assist them in their efforts to secure business. The potential purchaser, however much allowance he may be disposed to make for our natural inclination toward self-criticism and depression, is likely to take us at our own valuation and perhaps at even less than that. The *Journal* makes the definite statement that too much cabled pessimism is doing England harm rather than good in the U.S.A., and it adds: "the quicker this is realised the easier will be the task that the business interests of England are fulfilling so nobly."

Let us quote how British business men in New York regard the old country, for it may do us all good to see ourselves as they see us:—

"Admitting that official trade returns show that manufacturing output might be better, and that the trade totals of exports are below par, England is still doing a lot of business with the world. She has not lost her trade to competitors, as one might infer from reading the dispatches published in metropolitan papers, and emanating in part from official sources. She has not lost her supremacy in shipbuilding, even though the wording of the latest Lloyds' reports might be so construed. The business instinct which has placed England in her present proud position still lives. She faces the situation calmly—at least, her business men do—and they are not to be moved or alarmed by hysterical conjectures, theories, or prognostications that, for Great Britain, the sun has set. Far from it, they are looking for the sunrise of better times to come and with indomitable courage and perseverance will carry on. The war has been ended only about six years, yet England has restored the pound sterling to gold parity. She is paying her heavy debt to America, and the position of her banks, business houses, manufacturing plants and shipping enterprises is warrant not only that all is well, but that all will be well."

As we have stated on several occasions, the data that have had to be published here for the information of the community, including industrial workers, on high costs of production, are used against us by our competitors abroad, the effect being to create an impression that, on price, we are out of the running. We are not questioning the wisdom of letting the truth be known among our own people, for it is only when the facts are fully understood that real co-operation among all classes is likely to be secured. But we need not in the gloom forget all the bright spots. The electrical industry, at any rate, has ample justification for optimism in most of its sections.

It is a pity that so much is made of an occasional lost contract, while far too little is made of our manufacturers' successes. We are always pleased to publish particulars of British achievements for the information of potential purchasers in other lands. The more publicity that is given to what our works are doing the more likely is there to be a return flow of inquiries and orders from the oversea markets.

Pulverised Coke for Electricity Generation.

At the annual dinner of the Mersey and North Wales (Liverpool) Centre of the I.E.E., last February, Sir Max Muspratt referred to the importance of a cheap supply of electricity to the chemical industry, to enable it to meet the competition of countries that had water-power at command, and expressed approval of a suggestion that had been made—that coal should first be used for the production of gas, and that afterwards the resulting coke should be pulverised and burnt in boilers, thus making the best use of the coal. He suggested that problems of this kind should be worked out by co-operative action on the part of the representative institutions. Mr. W. B. Woodhouse, president of the I.E.E., said that the views expressed by Sir Max corresponded with those of the most advanced electrical engineers, and that with suitable plant it would be possible to supply electrical energy to the chemical industry at prices comparable with those resulting from the use of water power.

A point which we would emphasise in this connection is that, whilst the cost of fuel has comparatively little influence on the cost of electricity for short-hour loads, such as our public electricity supply stations have to deal with—the load factor rarely exceeding 30 per cent.—it is of first importance in relation to an industrial load, such as that of many electrochemical operations, with a load factor of 90, or even 100 per cent. Water power is cheap for long-hour loads, but not necessarily cheap for loads of short duration, because in the former case the heavy capital charges are distributed over a larger area, whilst the running costs are small. Thus, as Sir Max Muspratt pointed out, for electrochemical processes, in order to compete with water-power cheap fuel is essential, to keep down the running costs.

Sir Max's suggestion that pulverised coke should be used for this purpose is hardly capable of realisation, so far as it applies to ordinary gas coke, for this material is difficult to pulverise, and besides consuming far more power in the process than coal, is very abrasive, rapidly wearing out the pulverising plant. But an announcement in the daily Press last week puts the matter in a new light. A process for the low-temperature carbonisation of coal, it appears, has been developed and successfully tested on a commercial scale, in which the coal is pulverised before carbonisation, resulting in the formation of powdered coke. In an interview with a representative of the *Morning Post* the inventor, Mr. McEwen, stated that by the recovery of the by-products—oils and tars, &c.—from the carbonisation process, as well as of the gas, and the use of the powdered semi-coke for generating electric power, it was hoped to reduce the cost of power by half. An installation capable of carbonising 200 tons of fuel a day, he said, had been ordered by the Milwaukee Electric Railway & Light Co. to work on these lines.

Further information will be awaited with interest. Obviously, such a process would be capable of utilising coal to the best advantage, in the light of our present knowledge: fuel oil, motor spirit, tar, and gas would be derived from the coal, before the residue was burnt under boilers, and though the highest thermal efficiency as yet attainable in steam practice is only 20 per cent., still the reproach that all the valuable by-products of coal were wastefully consumed in the furnace would be removed and an important commercial economy would be effected.

Electricity Supply in South Africa.

In his valedictory address to the South African Institution of Engineers, Mr. T. G. Otley explained the circumstances under which the Witbank power station was put in hand by the Electricity Supply Commission of South Africa; the scheme had been criticised on the ground that the Victoria Falls and Transvaal Power Co., Ltd., was to obtain a bulk supply from the new station at cost price. Under the Electricity Act, said Mr. Otley, the Commission was bound to supply all consumers at cost, and in order to reduce that cost to the minimum, it was essential to enrol the Power Company as a bulk consumer; unless the Commission could supply electricity as cheaply as private enterprise could do it, the Control Board could not authorise the Commission to erect the station, and the load in the Witbank district, apart from the Power Company's demand, was not sufficient to justify the erection of a generating station. The Power Company could have extended one of its existing power stations, or built a new one elsewhere, in which case the Government scheme would have fallen through.

However, the company desired to co-operate with the Commission, and agreed to take from the new power station all output that was not required by the Commission for its own consumers, thus enabling the plant to be operated on the most economical basis, at the maximum load factor. This would appear likely to react upon the Company's other power stations, but the terms of the agreement provide for sharing the benefits equitably between the two parties. The arrangement will enable the Commission eventually to supply energy to the railways at a much lower rate than would be possible if a separate station for traction had to be erected.

The case is unique within our experience, and admirably illustrates our contention that increased output per unit of capital outlay is the essence of cheapness. Merely installing the most economical plant cannot result in cheapness of supply. In this instance arrangements have been made before-hand to ensure that the essential condition shall be fulfilled.

Boiler Practice on the Rand.

In the same address, which is abstracted elsewhere in this issue, the retiring president brought out some interesting facts relating to the four steam stations of the Power Company, in which 102 boilers are installed. Twenty-four of these boilers have been steaming at a load factor of between 70 and 80 per cent. for 17 years, representing, in comparison with average British conditions, a working period of 30 or 35 years;

yet they are to-day "virtually as good as when installed," and they are steaming at higher efficiencies than at any previous time in the history of the Company. The other boilers have worked for 13 or 14 years at the same load factor, and every boiler on the system is considerably exceeding the makers' rating, though they are burning coal of far lower calorific value than they were originally rated on. The high output is obtained by applying forced draught over a short length of the grate at the front end, and running the grates 12 or 14 per cent. faster than the speeds they were designed for. It was found advisable to use a separate fan for each grate, and by means of these the output can be increased by 15 or 20 per cent. when necessary. The induced draught is also to be increased, and it is hoped to raise the output by about 40 per cent. above normal rating.

Mr. Otley is a believer in large boilers; he sees no good reason why more than one boiler should be required to feed one turbine—even of 50,000 kW—except that it would take some time to heat up a spare boiler in case of need. Hence he urges that the boiler should be made as reliable as the turbine, and points out that in the experience of the Rand Power Companies the great majority of boiler stoppages are due to the mechanical parts—the grates, gear-boxes, &c.—and not to the boilers themselves; it is up to manufacturers, he says, to make these parts, which are simple compared with turbines and generators, at least as reliable, and to station staffs to maintain them immune from involuntary stoppage. The result of installing such large boilers would be reduced capital cost, simpler piping, &c., and—especially in the Transvaal, where coal is extremely cheap—simplicity of design should be the watchword. High thermal efficiency can be bought at too great a price for installation and maintenance.

Gas on Trains.

THE terrible accident which took place at Amiens on Thursday last week affords further evidence of the danger of carrying gas on railway trains. According to the *Morning Post*, "the only carriages which took fire were the fifth and sixth, which were the only ones on the train fitted with gas tanks." As we have observed on previous occasions, the horrors of a railway collision are ghastly enough without adding to them the mental agony of awaiting the approach of the flames and the physical tortures of a lingering death by fire.

Long ago the French Government realised that such risks must be removed, and issued a decree that before January 1st, 1923, gas lighting on express trains should be abolished; on suburban trains electricity was to be the sole lighting agency by the beginning of 1924, and in the course of that year all other trains must be lighted with electricity (ELECTRICAL REVIEW, October 28th, 1921, p. 555). Similar action had been contemplated in 1914, but was delayed by the war. Apparently the decree had not been fully carried out, though only two of the 21 coaches involved in the Amiens disaster were equipped with gas lighting. It has been officially stated that all the regular express trains are lighted with electricity, and only on holiday trains are gas-lighted coaches still in use.

There is no need for gas on trains at all. Electricity can not only provide illumination and ventilation, but can also perform all the cooking operations required on restaurant cars. The decree above-mentioned was the immediate result of the frightful disaster in the Batignolles tunnel; are we to wait for a similar holocaust in this country, before our Government will intervene and abolish gas on trains?

The Cost of the Electricity Commission.

IN the *Gas World* of August 15th, editorial criticism is levelled at the Electricity Commission on the ground that this body, "ostensibly established for the purpose of co-ordinating the electric supply of the kingdom," is pursuing competitive methods, of which the evidence is a circular letter with regard to the Advisory Committee on Domestic Supplies and Methods of Charge, addressed by the Commissioners to all authorised electricity undertakers. We are not concerned to defend the Commission against the charge of exceeding its authority, though we fully believe that it is acting in accordance with the spirit of its constitution; but we wish to point out that incidentally it is said to be "financed at the taxpayers' expense," and the statement is made that "The taxpayers' money is being used for promoting the well-being of one industry." This is a mistaken impression. It is true that the Exchequer advanced funds in 1919 to enable the Commissioners to make a start, but that loan has now been wholly repaid, and the Electricity Commissioners' expenses are borne entirely by the electricity supply industry, the excess of expenses over receipts being apportioned among the authorised undertakers of the country *pro rata* to their output. Last year the amount so apportioned was £75,000. The matter was fully covered in the Acts of 1919 and 1922, and we feel sure that our fair-minded contemporary, on having its attention drawn to the error, will rectify it.

On Exaggeration.

OVERSTATEMENT is a weapon often employed by propagandists. It startles the reader or the listener and fixes his thought upon a subject when possibly the truth and nothing but the truth told in moderation might leave him uninterested. "Stunts" on occasion justify themselves in the result, but the public tires of stunts, and once bitten becomes twice shy. Ordinary mortals clothe themselves in protective armouring, proof against exaggeration, and become critical and sceptical. Now, slogans are excellent in their way, and they serve their purpose for a time, but new ones should be ready to take their place before they are worn out. Electricity has had its slogans, and we could do with some arresting ones now, but they need not express exaggerated claims. Electricity is able to do so much and to do it all so well that exaggeration is quite unnecessary. The merits of electrical service—when it is given proper trial—are self-demonstrative. The purpose of the slogan or the propaganda claim is to impress the minds of those who do not *know*, but who need to be brought to fixity of thought regarding electricity and compelled to interest themselves in it. Therefore, publicity must be efficiently employed, forcefully but fairly stating its merits. Some criticism may be offered of those who have advocated it as a panacea for all industrial ills at a time when hundreds and thousands of men have been earnestly searching for a way out of most serious situations. Its advocacy as the householder's way of solving domestic problems requires discretion too, because, say what we will, in large numbers of homes there is not money to spare for electrical installation and supply at present costs. Convenience is worth much to many, but it cannot be paid for by all. Even with the "All-in" rate of the Electric House, the bill is not small compared to previous bills for lighting and heating—it is in convenience and cleanliness and labour-saving that electricity scores, and these are things which must be paid for. The consumer who is led on to the mains under false impressions as to cost is not going to be a help in the long run—he may even be a hindrance if he spreads abroad an anti-electrical experience. Overstatement or optimism is a very pronounced weakness with some who have the drawing-up of electrical company prospectuses, but Nemesis relentlessly dogs the steps of such, and extravagant promises have to be paid for by somebody. We have known extravagant statements to be issued to the Press by manufacturers' publicity departments—a most short-sighted practice to adopt. Self-respecting editors do not admit such into their pages, and the unavoidable result may be an inclination so to deal with over-statements as to make them briefer than they would otherwise be. Another class of over-statement that occurs to the mind is excessive praise of men; if it be laid on with a trowel it often fails in its intention, for it raises a smile but is not treated seriously by listeners. It does little harm, however, for most of us are wonderfully clever at discovering the depth of sincerity of such utterances.

Water Power in New Zealand.

The Government Hydro-electric Scheme at Mangahao.

(From a Special Correspondent.)

From its wealth of physical features New Zealand is able to derive a potential water-power supply of about 36 kW per square mile, and is second only to Switzerland in this respect. Resources examined by public works engineers indicate that from sources of over 1,000 kW capacity the country can produce a grand aggregate of over five million kW, and power from minor sources is estimated to amount to another two million kW. At the present time there are not more than thirty schemes

Fig. 1.—The Mangahao Dam.

in operation throughout the country, the great majority of these being small local schemes developing at most a few hundred horse-power. There are, however, several Government schemes already in operation, and these provide the great bulk of the 100,000 kW developed in the country at the present time.

Government schemes in contemplation include the harnessing of the Arapuni Rapids on the Waikato River, developing 120,000 kW at a cost of five and a half million pounds. The Waikaremoana Lake project is now being commenced, and involves the development of 60,000 kW at an estimated cost of two and a half million pounds. Other schemes for the future include the utilisation of Lake Te Anau to develop over a million and a half horse-power—this will be one of the largest works in the world.

One of the completed Government schemes is the Lake Coleridge development on the Rakaia River for the purpose of supplying the city of Christchurch and other towns on the Canterbury Plains with electricity for lighting and power. The present plant utilises the waters of the lake by taking them through a tunnel a mile and a quarter long, giving a head of 480 ft. The capacity of the plant is 15,000 kW, consisting of four 1,500-kW and three 3,000-kW sets. Power is generated at 6,600 V, three-phase, and transmitted about 60 miles at 66,000 V to a main sub-station on the outskirts of Christchurch. The primary distribution is at a pressure of 11,000 volts, at which it is sold to the local retailers. Secondary distribution is at 3,300 and 400 volts. Work is proceeding upon the extension of the capacity to 36,000 kW.

The largest Government scheme is the newly-finished Mangahao station at Shannon designed to cater for the city of Wellington and the provincial towns. The construction of this project presented some difficult and unusual features, and the work was constantly interfered with by a regular succession of heavy floods, which time and time again nullified the accumulated efforts of the large body of men employed. The principal works at Mangahao are two large storage dams at Mangahao and Tokomaru, 186 chains of concrete tunnelling, a surge chamber 75 ft. deep, pipe lines and power house, and transmission lines and nine sub-stations.

The construction of the dam at Mangahao (fig. 1) was the most difficult job in the contract. It was originally intended to erect an arched concrete dam containing about 9,000 cubic yards, but owing to vagaries in the rock it was decided to build it partly as a core-walled earth-filled dam, and partly as a gravity section overtopped concrete dam. The concrete core wall is carried down into the country rock for a distance of several feet. The gravity section portion contains two automatic filting gates, which are so constructed as to retain the water at a constant level against floods. The passages in which the gates operate are each 64 ft. wide and 10 ft. deep, and the gates operate on pivots placed just less than half way up their sides. These gates are balanced in such a way that, when the level of the dam rises above normal, water enters a siphon and flows into a chamber behind the lower portion of the gate. The balance of the gate is then disturbed and it tilts slightly forward and permits water to run over the dam face. The amount of water entering the chamber determines the tilt which can be as much as right angles to normal, and this represents a sudden rise of three inches in the level of the dam. When the level of the water again falls to two inches below the normal level of the dam, air is drawn into the siphon, whose action is then interrupted, the water in the chamber drains away and the gate resumes its normal position. The installation of this device obviated the necessity of raising the level of the Mangahao and Tokomaru dams another 10 ft. The tunnels joining Mangahao dam with Tokomaru dam, and the latter with the surge chamber, are controlled by motor-operated gates, which enable either dam to be emptied without affecting the level in the other. The surge chamber (fig. 2), which is situated at the lower end of the second tunnel, is shaped like a volcanic crater, and is 87 ft. in diameter at the top, 75 ft. deep, and 19 ft. in diameter at the bottom. From the surge chamber a 72-in. pipe line in duplicate

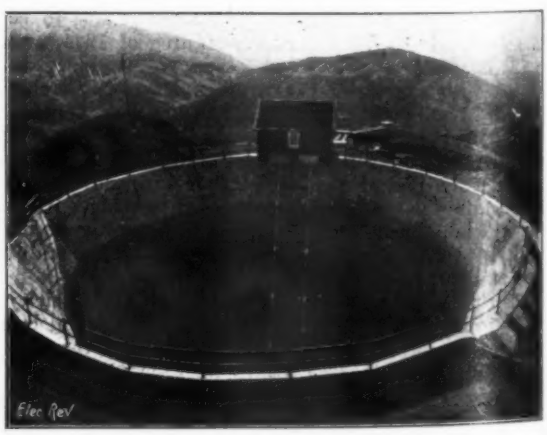


Fig. 2.—The Surge Chamber at Mangahao.

emerges, passes successively into 66-in. and 60-in. pipes, and then breaks into four 41-in. and finally 36-in. pipes on entering the power house.

The power house (fig. 3) is a substantial concrete building, 215 ft. long and 84 ft. wide. In the basement of the building are the main pipe and valves, bus pipe, turbine and generator pits. The main floor contains the turbines and generators on one side, the reactances and l.p. switchgear in the centre, and the

transformers on the other. Above the l.p. switchgear is the switchboard gallery, with the offices alongside.

The main pipes, bus pipes, and valves are so arranged that any pipe or turbine may be isolated without interfering with any of the others. The generator room contains three 8,000-h.p. and two 4,000-h.p. Pelton wheels, driving respectively 6,000-kVA and 3,000-kVA alternators. All the machines can be excited by two independent 250-kW d.c. generators. Governing is by needle valve and deflector operated by oil pressure and driven off the main generator shaft.

In the transformer room are two banks of three 4,000-kVA single-phase transformers and one in reserve, capable of raising the pressure from 11,000 to 110,000 V*. The various Power Boards will receive the current at 11,000 volts from the sub-stations and transmit it at their own pressure to their clients. The Wellington City Council has arranged to take over 12,000 kW from the Mangahao undertaking. The City Council's own plant at Evans Bay will continue to operate for the purpose of relieving the Mangahao supply at peak hours. A typical transmission line pole is shown in fig. 4.

Mangahao is the largest Government station in existence at the present time, developing 24,000 kW, and has cost approximately £1,600,000. Further works consist of an additional storage dam behind the Mangahao dam, and the erection of several sub-stations, together with the duplication of the main transmission lines, finally linking up with the Arapuni and Waikaremoana schemes.

We are indebted to the Publicity Department of the New Zealand Government for the illustrations in this article.

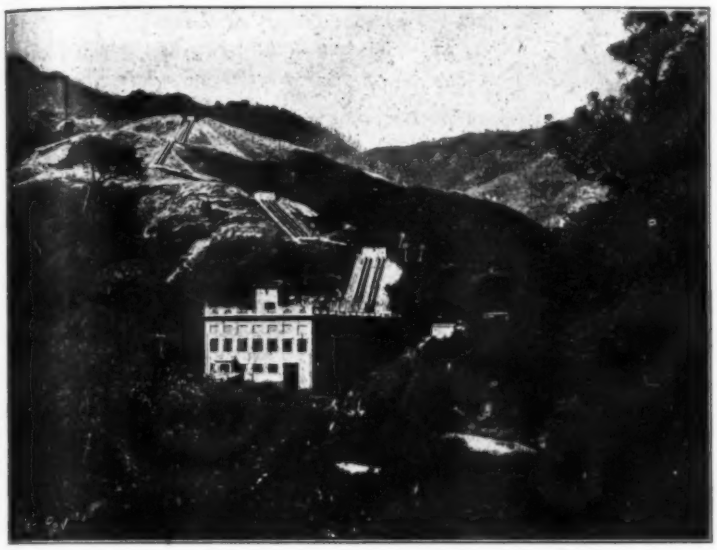


Fig. 3.—View of the Power House and Pipe Lines.

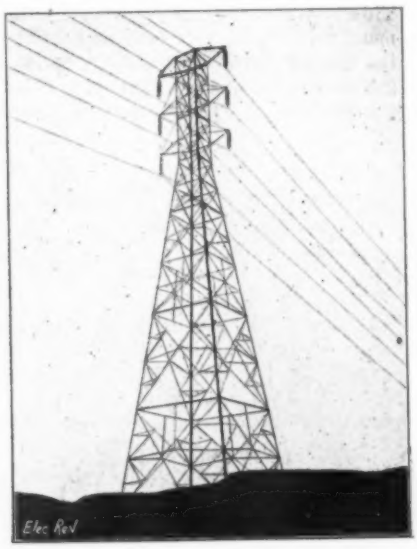


Fig. 4.—A Typical Transmission-line Pole.

Induction Heating by Low-Frequency Currents.

The Use of the Induction Furnace for Melting Non-ferrous Metals.

By G. E. TAYLOR, A.M.I.Mech.E., A.M.I.E.E.

THE heating and melting of metals by means of induced electrical currents is perhaps the nearest approach to the ideal method of heating that science has yet made possible, for the heat is generated in the material itself. Thus, the necessary containers or crucibles are at a lower temperature than the charge, and a maximum heat efficiency is obtained.

The first to recognise the great possibilities of this form of heating was de Ferranti, who took out a patent in this country in 1887. The same year Edwin Colby, of Newark, N.J., took out patents in the United States, and some time later he constructed an induction furnace which consisted of a single ring of molten metal, forming the secondary, placed round an iron core, the primary being placed outside the secondary.

Kjellin, and subsequently Frick and Rodenhauser, were responsible for the design of the induction furnaces in European works, which were successful for limited metallurgical applications in the steel trade, but this development has almost ceased in recent years on account of the better metallurgical conditions obtained in the arc furnace, which is superior for refining purposes. The necessity of using extra-low frequencies, such as 5 to 15 cycles per second, was also an important factor in preventing the development of induction heating as applied to the steel trade, owing to the capital expenditure necessitated by the installation and maintenance of special generators which were not suitable for other purposes.

The application of induction heating to the non-ferrous metals has given a new impetus to this type of furnace, and as this is usually performed in small units, the furnaces now used can be designed to give good power factors when working at normal commercial frequencies.

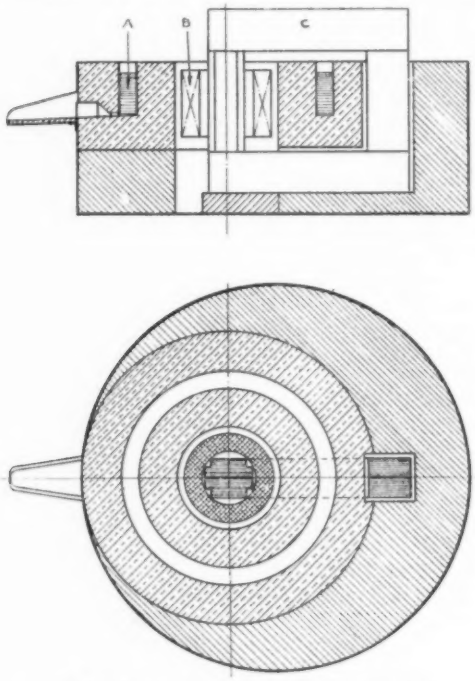
The principle of the low- and normal-frequency induction furnace is that of the static transformer, that is, it has primary and secondary circuits which are magnetically interlinked by a core of iron, the power supplied to the primary being transferred to the secondary by means of a fluctuating magnetic field and there turned into heat; as a transformer, it is extremely efficient, for whereas the heat generated in the secondary of a transformer is a form of loss, in the induction furnace it is utilised.

Its design also closely resembles that of a transformer. This is illustrated in fig. 1, which is a usual method of construction.

* See ELEC. REV., October 20th, 1922; p. 557.

The metal (A) is contained in a horizontal ring, placed concentrically with an iron core (C) of transformer iron, on which is placed the transformer winding (B).

It will be seen from the sketch below that whereas in the transformer the primary and secondary windings are close together, in the induction furnace a very large space of necessity exists, filled with refractory lining, thus forming a large leakage area for the magnetic field and giving a correspondingly poor power factor. This space varies greatly with the temperature of the metal to be melted and the size of the furnace, but in the most favourable circumstances it is comparatively great, and also, as the secondary channel has to take the complete charge, the cross section of this channel is



(A) Molten metal; (B) Primary coil; (C) Iron core.

Fig. 1.—Low-Frequency Induction Furnace for Melting Steel: Vertical and Horizontal Sections.

large, if its diameter is to remain within practical limits; thus again we get adverse conditions for maintaining a high power factor.

Many methods have been adopted by different inventors to reduce the magnetic leakage, and to a certain extent the power factor has been improved.

In starting up an induction furnace it is necessary to pour into the secondary channel sufficient molten metal to form an electrical circuit of a cross section large enough to take the current required to heat the charge. After this has attained the desired temperature, cold scrap is added in small quantities until the complete charge is molten. After pouring the metal, a sufficient quantity is left in the channel to form the necessary circuit for the next charge.

With the open-channel type of furnace, the cross section of the bath varies according to the weight of metal charged; its resistance will likewise vary, so that with constant voltage the current flowing in the channel will be smaller at the commencement than after the complete charge is molten.

For example, if a furnace, when charged to half its capacity, takes a load of 143 kW at a power factor of 88 per cent. with 10 volts across the secondary channel, we shall have the following electrical conditions:—
kW 143; p.f. 88 per cent.; volts 10; amperes 16,200; ohmic resistance 0.000544; reactive resistance 0.000292 ohm.

When the full charge has been added, the ohmic resistance will be halved; the reactance will be as before, and the power factor will be cos ϕ, where tan $\phi = .000292/.000272$. Then cos $\phi = 0.68$. The impedance is now .0004 ohm.

The current flowing will be, assuming the voltage to be constant $10/.0004 = 25{,}000$ A, and the power taken will be $10 \times 2{,}500 \times 0.68 = 170$ kW.

From the above it can be seen that the power factor varies considerably according to the state of the charge in the furnace. The rate of heating also varies—that is to say, although the charge has been doubled, the kilowatts have only increased by about 20 per cent. However, if a means of voltage regulation is adopted, the power may be increased to a certain degree, depending upon the current density of the bath.

Owing to the phenomenon known as "pinch" effect, there are well-defined limits beyond which the current cannot be increased. Therefore the maximum electrical power of the furnace equipment cannot be used throughout the whole charge, unless a large proportion of the molten metal be left in the bath; consequently the load factor will be low.

When large furnaces of the simple ring secondary type are used, it is necessary to reduce the frequency, the usual practice being to install machines of the motor-generator type so that three-phase currents may be taken from the line, and a single-phase current of the required frequency delivered to the furnace. As the motor is usually of the synchronous type, it is used to advance the power factor.

The Rochling-Rodenhauser furnace deviates from the usual method of construction and makes use of polyphase currents. This is perhaps one of the greatest improvements in the induction steel furnace. Its arrangement is such that it may be connected to standard supply circuits without having an unduly low power factor.

Dr. Carl Hering noticed that when current was passing through a molten conductor contained in an open trough, deep depressions of the liquid metal took place on the current reaching a certain density. This effect is known as the "pinch" effect, and has considerable bearing on the design of modern induction furnaces.

It is well known that parallel conductors carrying current in the same direction attract each other. The molten liquid contained in the secondary of an induction furnace may be looked upon as an indefinite number of parallel paths, through which the current is flowing. Each of these paths will tend to move towards the axis of the conductor, and should the current density be raised beyond a certain point, the force will become great enough to interrupt the circuit momentarily. Hence there are limits to the current density which may be allowed in the molten secondary.

The force due to what is known as "motor" effect also has a very important bearing on induction furnace design, especially in the case of the Ajax-Wyatt furnace for melting non-ferrous metals, which is described later.

Most of the earlier induction furnaces were developed for the melting of high-resistance metals, such as steel, &c., very little attention having been paid to the melting of non-ferrous metals and alloys, such as copper and brass. Experiments, however, were carried out some years ago on the melting of non-ferrous metals by an induction furnace of the open-channel type, but without much success. The poor results of this type of furnace for non-ferrous metals and alloys were principally due to the low power factor and "pinch" effect.

Owing to the higher resistance of steel, the current density required to melt at a practical rate may be adjusted so that the "pinch" effect does not reach a sufficient magnitude to break the secondary, but in the case of low-resistance metals the current density for practical melting in a horizontal ring furnace may be so great that the "pinch" effect will break the molten metal circuit. The power factor of the secondary channel will also be lower than that of steel, and the resistance may be so variable that the furnace will become impracticable.

It is, however, in the melting of non-ferrous metals and alloys of the copper-zinc type that the characteristics of the induction furnace are much more favourable than those of the arc furnace. In melting steel and ferrous alloys, unless very pure expensive scrap is used, it is necessary to refine the molten metal. To do

this, it is important that the slag should be hotter than the molten steel, so that the chemical actions for the removal of impurities may take place. In the arc furnace these required conditions exist, whereas with the induction furnace, as the slag is a poor conductor of electricity, it is extremely difficult to generate sufficient heat in it to hold it at the required temperature.

On the other hand, when melting copper-zinc alloys, owing to the low volatilisation point of zinc, it is important that no part of the bath shall be heated to an excessive temperature. In the arc furnace this condition is not easily obtained, but with induction heating the temperature can readily be kept within the desired limits.

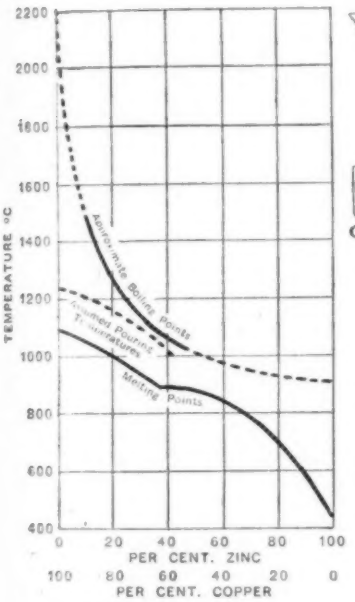
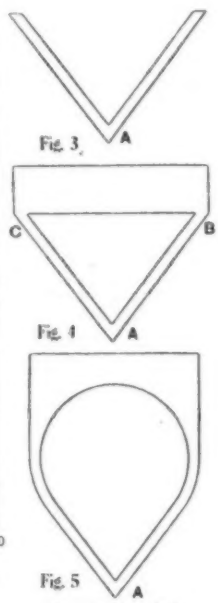


Fig. 2.—Temperature Curves for Copper-Zinc Alloys.



Figs. 3, 4 and 5.

The above three curves, fig. 2, were prepared by Mr. H. W. Gillett, of the U.S. Bureau of Mines. The upper curve shows the temperature at which zinc volatilises in the various copper-zinc alloys; the lower curve is that of their melting point, and the centre curve the temperature at which they are usually poured.

In the case of the important commercial alloys, namely, those containing from 30 to 40 per cent. of zinc, very little difference exists between the temperature required for successful pouring and that at which the zinc in these alloys volatilises. Therefore, the control of heat and the temperature at which the heat is applied to the metal are of the utmost importance.

It is obvious then that for these alloys the open horizontal-channel induction furnace is limited in its application, owing to the low power factor, the varying input, and "pinch" effect, and the arc furnace is unsuitable, owing to its heavy zinc losses.

To overcome the various difficulties, C. P. Schneider constructed and described the original closed-channel type of furnace, in which the ends of the channel terminate in a bath of molten metal placed above them, which maintains pressure in the channel. The circulation of the metal in the secondary channel was not sufficiently great to prevent the metal becoming overheated, and the furnace therefore was not practical.

James Wyatt, when carrying out experiments in the development of the electrode "pinch"-effect furnaces invented by Dr. Carl Hering, noticed that a peculiar action was taking place in the molten metal. Experiments were carried out to find its cause, and from the data gained the type of closed-channel furnace known as the Ajax Wyatt was developed.

From the experiments undertaken by Wyatt, it was found that on passing current through a molten metal conductor contained in a rigid channel, a strong repelling action took place wherever a well-defined angle was formed, this action tending to bank up the metal against the side of the channel. When an acute angle was formed, as shown in fig. 3, a strong action took place which tended to bank the metal at A and caused a flow of metal away from that point.

If we join the two ends of the conductor in a bath of metal as shown in fig. 4, banking will take place at A as before, but the flow of metal away from this point will be retarded owing to a similar effect, although of less magnitude, taking place at B and C.

If we require the metal to have a maximum rate of flow along the sides adjacent to A, we must round off the corners at B and C, as shown in fig. 5.

From these experiments it was clear that wherever a sharply defined angle was formed, a certain magnetic effect was taking place on the molten metal. Also, where such a force is exerted, it tends to eject molten metal from the channel, and the corners at the point where the ends of the channels meet the bath must be rounded off to obtain a maximum rate of flow.

The present type of Ajax-Wyatt furnace has been designed to utilise the force due to "motor," "pinch," and "Joule" effects to the best advantage.

(To be continued.)

Cheaper Power.

Suggested Combination of Gas and Electricity Production.

By W. D. WYLDE.

THE present-day advocacy by the powers that be of the super type of super-power station as a means of producing a plentiful supply of cheap electrical power, will no doubt to the layman appear to be the stepping stone to real and rapid progress towards putting our staple industries on their feet, and towards the conservation of the nation's fuel resources. The fact remains, however, that the most up-to-date plant in existence as a commercial proposition at the present time, utilising steam as the working medium for power production, only makes use of 25 per cent. of the heat value of the raw coal consumed; and what is more, this figure is only obtained and maintained by the adoption of the most modern types of fuel economisers, ceaseless vigilance, and scientific methods of plant operation applied continuously. In the absence of these aids, the figure would fall to 15 per cent., which may be taken as that obtaining in the majority of modernised municipal and power companies' power stations at the present time. It does not require a great deal of calculation to show that, assuming that the super-station with the higher efficiency supplies energy to large consumers at 0.75d. per unit, by adopting methods of power production resulting in a 40 per cent. coal utilisation efficiency the price of energy to the same consumer would be a maximum of 0.5d. per unit, taking it for granted that the power supplier would be content with the same profit margin as before.

To enable the higher efficiency of coal consumption to be attained, it is absolutely essential that the efficient methods of coal treatment developed by the gas industry be combined with the modern methods of utilising at maximum efficiency the heat at its disposal evolved by the electricity supply industry, and as a means to this end amalgamation of the two industries is suggested. The reason for the foregoing suggestion

will be seen when the valuable elements that make up the conglomeration that goes by the name of coal are taken into consideration.

Coal is well known to contain in varying quantities volatile hydrocarbons—valuable substances which by the distillation process are recoverable in crude forms, the degree of further refinement being decided by the market values of heavy and light fuel oils ruling at the time. The residual solid matter in the form of a baked carbonaceous mass is a useful commodity for the domestic fire, steam boiler firing, and other industrial heating requirements.

The main deciding factor is, of course, the value of the hydrocarbons in question: whether their value in by-product form exceeds the value of the heat produced by burning them immediately they are liberated from the raw coal, which is the case when utilising raw coal in the boiler furnace.

It may be useful to examine briefly the cause and effect of splitting up the coal disintegration period into two distinct, although interdependent, processes for the ultimate realisation of the aims in view, which are included under the title of conservation of the potential assets of coal. The cause is simply the fact that at the present time this country is dependent for 80 per cent. of its oil fuel needs on supplies from abroad, the 20 per cent. produced at home being from the high-temperature carbonisation process of existing gas works and coke ovens—maximum gas yield per ton of coal carbonised taking precedence with the former, and maximum coke yield per ton of coal with the latter.

Also included in the cause are existing economic demands, which make compulsory the utilisation to the full of the potentialities of the nation's most valuable natural asset, which the present-day method of consuming raw coal industrially and domestically does not do. By the universal adoption of the gas industry's most modern methods of coal treatment, an augmented supply of fuel oils would be available, with the beneficial result of reducing the dependency of this country on supplies from abroad.

There are other by-products, such as alcohol (which, incidentally, mixed with the by-product benzol, produces a motor fuel bordering on perfection); ammoniacal liquors, for fertiliser production; creosote oil, for disinfectant and wood-preserving purposes; and pitch, for road-making—to mention only a few of the products of commercial value that are recovered.

There is also smokeless fuel, the residue remaining from the aforementioned process, available to meet household and industrial requirements and to promote smoke abatement.

Coupled with the foregoing products there is a large volume of gas of relatively high heat value, an outlet for which is easily found, *viz.*, boiler firing for electrical power production and the augmentation of existing town's requirements, in the event of gas making further headway as a heating agent for household purposes.

The total effect realised by the removal of the coal distillates, as part and parcel of power production, is the conservation of the valuable chemical ingredients which in the ordinary way would either be partly destroyed and their heat value diminished, or wasted entirely in soot production and atmospheric pollution. The former is the result of boiler firing with raw coal, the latter the result of using coal in its mined state for domestic purposes.

In stating the reasons for the advocacy of a gas and electricity supply combine, it is not intended to convey the impression that such a combination would cause the original power production efficiency to increase by leaps and bounds. The inherent properties of steam as a power-producing medium with present-day boiler pressures and methods of steam utilisation unfortunately do not allow more than, say, 5 per cent. increase in the maximum efficiency to be obtained by up-to-date plant. There would, however, be an increase of at least 20 per cent. in the overall efficiency of the coal utilisation—in other words, 20 per cent. of the initial heat value would be recovered in the form of tarry vapours, and gas, with their subsequent use to the best advantage, chemically and thermally, resulting in a saving of the equivalent of 4 cwt. of raw coal for every ton originally consumed in its mined state in the boiler furnace. The foregoing simply means that the self-contained process of smokeless fuel, by-product, and electrical power production, enables a 20 per cent. increase in the overall efficiency of coal consumption to be effected. The economic advantages of the joint operation of the two industries under consideration may be itemised as follows:—

(*a*) Conservation of potential heat in liquid form.
(*b*) Recovery of the chemical constituents of coal.
(*c*) Introduction of semi-coked fuel for universal use.
(*d*) Incandescent coke used for boiler firing.
(*e*) Surplus gas available for boiler firing.
(*f*) Utilisation of waste heat from coal-treatment plant.

The economy derived from (*a*) will be appreciated when it is realised that the consumption of raw coal for domestic purposes results in the deliberate waste of 25 per cent. of the potential heat value of the coal, in the form of tarry vapours passing away to the atmosphere unburnt.

Applied to power plant, the economy is less pronounced, being about 10 per cent. for the older types of boiler-firing equipment, and from 3 to 5 per cent. with modern boiler-house practice.

Referring to (*b*), the economy accrues from the recovery of the alcohol and benzol compounds, which in the ordinary way of burning coal in its mined state give off only a fraction of their real heat value previous to their being classified as waste gases.

The beneficial asset (*c*) is the saving of the raw coal's material value by the low-temperature carbonisation process, coupled with smoke abatement and decreased expenditure on household soot removal. These results in turn would benefit humanity by the healthier atmospheric conditions that would prevail in our large industrial centres when their existing smoke screens were removed. In the case of (*d*) the economy is the result of utilising the carbonised coal forthwith for boiler-firing purposes, for electricity supply, without its being quenched, thus cutting out the heat loss incurred by slaking the product previous to its being stored or transported.

Item (*e*) plays a prominent part in the realisation of economy due to the surplus gas being used for steam production with a corresponding decrease in the consumption of solid fuel used in conjunction with the gas for boiler firing.

The last, but not least, item (*f*) materially assists in the maintenance of maximum efficiency by making use of heat which, although it has done the work primarily intended, is still capable of being exploited as a means of obtaining further economy in preference to the slipshod practice of allowing it to go to waste. In the light of the foregoing, the conclusion may be safely arrived at, that compliance with the demands of progress necessitates the abolition of the present-day methods of coal destruction and the substitution of methods whereby the maximum economy of conversion from coal into oil and power may be attained, and the elimination of waste may become a reality.

As a means to this end, the changing-over of gas works and coke ovens from the present high-temperature process of gasifying coal to the more progressive process of low-temperature carbonisation is suggested, which is simply the lowering of the temperature to which the coal under treatment is subjected, and the necessary increase in the capacity of the distillation and by-product recovery plant for dealing with the increased tar-oil recovery. This, in conjunction with the utilisation of the surplus gas for power production, a ready market for the smokeless fuel at a price comparing favourably with that of raw coal, and the reclamation of the most valuable fractions of the crude oil, should at any rate be the forerunner of the rightful demand of industry at the present time, *i.e.*, cheaper power.

On Finding the Right Man and Keeping Him.

Some Suggestions regarding Procedure.

By W. ROLAND NEEDHAM.

MUCH has been written urging the advisability of finding men suitable employment; and certainly one can scarcely over-emphasise the importance of that training which fits men the better to succeed in their life work. Less has been written in the different, though not necessarily opposed, sense of stressing how necessary it is that the right man be either found or *grown* for a particular job. The latter is, of course, one of the commonest quests undertaken in commercial and industrial life. Every Press advertisement for a man to occupy a certain position is a case in point. Scarcely 10 per cent. of those appointed through these media, however, really *fill* the positions they occupy. Many, indeed, may be likened to circular pegs which fail even to touch the square holes they are placed in. They are misfits who make no real contact at all.

In this matter of seeking the man for the job, even given the most wisely conceived, carefully engineered recruiting scheme possible, more often than not the results would be below rather than above what would probably be considered a reasonable mean; and as things are, it is not at all surprising that in the majority of cases the end desired is but very indifferently realised. It would indeed be strange were it otherwise, having regard to the haphazard means employed.

It frequently happens that the advertisement column of a newspaper or technical journal provides a man with his only avenue of approach to betterment in position. Whether he deserves such advancement or not is here beside the point. As a plain matter of fact this facility offers him his chance, and many a man eagerly accepts the opportunity.

But how about finding the right man for the job? It is very questionable whether, in the majority of cases, he will be captured in this way. How is an employer to be guided? What standards of comparison will he establish? What criteria will he adopt? Can he hope by a series of carefully chosen questions to test a candidate's qualifications rigorously enough? Shall he trust to his skill in cross-examination, or to his more or less instinctive appraisal or distrust of a man's general deportment and calibre? Are the candidate's credentials, or is the ostensible range of his experience, to decide matters? Some uncertainty there needs must be. This may not be obviated. The aim should be, however, to reduce the element of risk to a minimum. The present writer is strongly of opinion that the ordinary Press advertisement medium, and the customary procedure attendant thereupon, do not tend to liquidate this uncertainty. It may be worth while to consider a little more fully what are some of the points at issue.

Many a specious fellow has boundless assurance. If he have just sufficient knowledge and acumen to enable him to dissemble and cloak his limitations, he can by sheer nerve and bluff deceive even the shrewdest observer *for a time*. It is upon more intimate knowledge, and up against the real issues which test a man's worth, that the material is found to be under specification.

A good testimonial is not always the thing it purports to be. It is by no means a thing unknown for an amiable employer to present a man, whom secretly he is relieved to release, with notable credentials. He presumably works on the easy-going principle that if an employé is not good enough to be retained, he need not be penalised on that account. Thus a good-natured gesture is made, and "the poor fellow is given the best reference possible." Despite the fact that more and more the practice is growing whereby a testimonial is made to be a plain, unvarnished record of services rendered, the older variety is by no means dead.

Then as to the range of a candidate's experience, the employer should nicely discriminate and seek the golden mean. Between the radicalism of the rolling stone and the conservatism of the stick-in-the-mud, there is well-nigh infinite variety of gradation. Range of experience may be as necessary as depth. Into the equation must enter the psychological and the temperamental factors as well. An energetic, forceful applicant will insist upon scope and elbow room. His nervous energy must find outlet. In parenthesis, be it said, the employer who on other grounds is favourably disposed towards such a candidate will seek to provide at least air space wherein such a man may breathe freely. If, on the other hand, the job demands that a man shall apply himself closely, that intensive detail work be required, then a more studious type of worker should be sought. Where the difficulty really arises is, however, just in the matter of the employer's judgment upon the miscellanea he has to inspect. He has to remember that a fine presence is not a necessary concomitant of a well-balanced, liberally equipped, and tactful personality. It is not all men who have journeyed far who really know much of the countries they have traversed. Many men understand Nature, are intimate with its lore, hear its voices, who have seldom wandered from one particular stretch of moorland or countryside. Nature's treasures are no secrets to the lovers of Nature. And so, on paper, a man may be able to reel off a most formidable itinerary of service, but in fact he may be a most ignorant person. Ostentation without substance, froth without body, swank wedded to incompetence—these things are of those which happen, and even keen judges of character do well to remember this. A solitary interview may not be sufficient; in fact, it is seldom sufficient. Actual working conditions provide the only valid test.

As a necessary corollary to the foregoing, a very modest, unassuming paper record may really have reference to sterling work and most valuable experience. The range may be limited, and looked at from that *partial* standpoint only, the data must be extremely incomplete. The ground, restricted though it be, may at the same time be well broken up, thoroughly reclaimed, and intensively cultivated. The employer should on no account overlook this possibility. Here again, however, from a merely paper programme, and from first impressions of an applicant's demeanour, how can he hope to form other than a haphazard opinion? Sometimes your best qualified man suffers from temporary nervousness. If this be at all apparent, what construction is the alert interviewer to put upon it? Is it necessarily a sign of weakness? On the other hand, is boundless assurance a sure mark of competence? It is well to emphasise how onerous, not to say thankless, is the task which devolves upon those who are called upon to make these important decisions. The data should be as complete as is humanly possible; but where the ordinary advertising methods are in vogue, are the desired conditions realised? Can they be realised under such auspices? Is there any other method available by which the gaps may be bridged, or at least reduced? The present writer believes that in many instances more facts might be educed, fuller knowledge gained, and thus material be at hand by means of which a sounder judgment is possible. The present article concludes, it is hoped, on a constructive note. The suggestions are not to be regarded as original. The deductions which may be drawn from them, however, should help matters forward quite appreciably.

Excellent results can be, and in fact often are, obtained when employers grow their own men. So long as it is realised that no one expedient, however good, can be relied upon to meet every case, no one key release every lock, the principle is sound. No horticulturist seeks to raise every kind of plant from antecedents he happens to possess at one particular time. New strains

must on occasion be introduced, lest such variations as eventually appear be too limited in range and depth. These limitations, be it remembered, are emphasised as time goes on, both depth and range of operation decreasing. Similarly it is vitally necessary at times to recruit the human material, to infuse fresh blood into the organism. Stipulating this proviso, it is suggested that the proven men on the spot are, in the majority of cases, more promising material upon which to draw, than is the stranger who must of necessity be selected in a hurried and somewhat fortuitous manner. Better men may, of course, apply for a given post than any to be found on the existing staff. It is highly problematical, however, whether any one of these better men will be the successful candidate. More likely than not the choice will fall upon one less equal to the task than several at the time in the particular firm's employ. This kind of thing happens times without number. Wise and far-sighted policy will insist that the intelligence department of a concern be wide awake and functioning. Thus, whether John Brown himself know it or not, if he show promise for doing better things than the very good things his restricted conditions permit, then John Brown should most certainly be ear-marked for the larger position which one day shall fall vacant. If John Brown is not so docketed, his employer richly deserves to lose him. Unquestionably by accepting a more lucrative and responsible position with a competitive firm, Brown inflicts upon his former employers a double loss. They lose directly, in that valuable service is withheld from them, indirectly because it is transferred to a leading competitor. The latter loss may quite easily be as serious as the former.

It is a veritable truism that nothing so crushes initiative as constant, unvarying repression. This repression need not be of the virulent aggressive type. Indeed, the most dangerous form it can assume is when it results from sheer inertness. Let men once conceive the idea that promotion is only possible with *another company*, and the best men will leave. Such as remain are seldom better than second rate, and even good men lose their zest and zeal and, so doing, lapse into mediocrity. Wideawakeness, initiative, the ability to visualise requirements and satisfy them—these are things to encourage; and encouraged, they pay extremely well.

Where it is necessary to seek afield for new talent, it is well to cut the risks as much as possible. If it is a really responsible post which has to be filled, it is excellent policy to hasten slowly. It takes time to make a good search. Not one interview only, but a serious collecting of facts, and a painstaking verification of them are often well worth while. The writer has known of enlightened engineers who have thought well ahead of events. They have arranged special interviews for the sole purpose of getting into touch with promising men. Then, when in later months the position has actually become vacant, relevant facts have been at hand and have been pressed into use. Responsible engineers can, if they will, acquire a surprising grip of salient facts. To do this, they must keep eyes wide open, and they should especially cultivate the scout sense. This is at once a gift and an acquisition.

Messrs. Benjamin Bent & Co., Ltd., requiring an assistant works manager, advertise locally and in the leading technical journals. Out of some 80 applicants, interviews are arranged with eight. Seven duly appear, and eventually, without undue difficulty, the running falls to two. The one with the better paper record, unfortunately for himself, exhibits some slight signs of nervousness. Benjamin Bent, being all out for *presence*, offers the post to the more feasible candidate, who, whatever else he lacks, has confidence enough. Six months later Mr. Bent offers the post to Mr. Nervous Man. He, having formed unfavourable opinions of Mr. Bent, refuses. Next, another of the seven has his chance. He, a really capable man, accepts provisionally. His own people, however, are loath to release him, and make him a firm counter-offer, which, after due consideration, he accepts. Then, and not till then, does Benjamin Bent get down to facts. He noses round, and finds that his assistant chief draughtsman has had an exceptionally good record, has effected marked economies, not only in office and routine work, but in certain workshop processes also. Further, he discovers that foremen moulder, pattern maker, machinist, and storekeeper value his advice and opinion very highly. In the end Mr. Assistant Chief Draughtsman becomes Mr. Assistant Works Manager, and eventually works manager, and secures at the same time a place on the board of directors.

The foregoing is a purely hypothetical example. It is also a parable.

The Motor Repair Shop.

Some Notes and Instances.

THE following notes have been based on experiences gained in the running of a motor repair shop by the Walker Electrical Service, Edinburgh.

The main generator supplying a large tweed mill, a 460-volt, 100-kW, 4-pole machine with 4 nine-brush spindles, developed heavy sparking at the commutator. The trouble was entirely due to badly carbonised

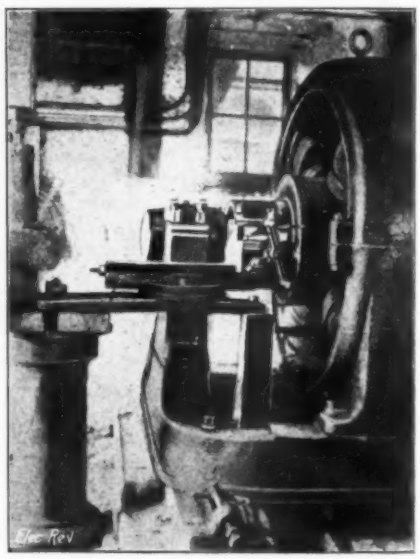


Fig. 1.—Method of Turning a Commutator.

intersegment micas, and also the breaking down to earth of the front mica vee ring. The front ring was removed, and the cast-iron vee was taken back to the repair shop to have a new mica ring fitted, it being thought inadvisable to attempt to make such a mica ring on site. The vee was 15 in. in diameter and 4 in. wide. As some of the micas were very badly burned down between the segments, the micas were scraped out and the spaces filled up with commutator cement. Some of the micas were actually burned down a distance of $\frac{1}{8}$ in. or so below the surface. A drop test was taken all round before filling in the cement to ensure that no "shorts" would be locked in with the cement. After reassembling the commutator, final tests for "earths" and "shorts" were made, when arrangements were made for the truing up of the commutator. A temporary cutting device was built up around the commutator, and the generator was driven by means of a motor fed from a small stand-by set.

Fig. 1 shows the method of turning the commutator. More time was spent on the rigging-up of the turning gear and the turning of the commutator than on the actual electrical repairs. After seven weeks' running without trouble, heavy sparking again developed. This time the complete armature was withdrawn and removed to the repair shop, and the commutator was rebuilt with

new micas, and after seven months' service the generator is giving entire satisfaction. The rebuilding of the commutator was not put in hand to begin with because, owing to pressure of work, the quickest repair possible was necessary.

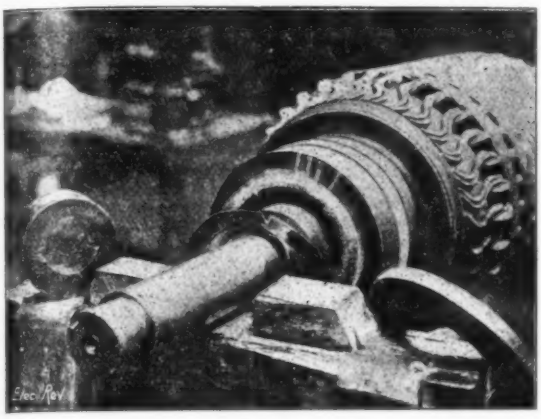


Fig. 2.—A Faulty Commutator.

Another instance of commutator trouble shutting down a main set in another mill has recently occupied the attention of the repair squad. A low-voltage set having a commutator 24 in. in diameter with 306 bars developed a number of badly carbonised "shorts" between commutator segments, and it was decided to replace the faulty mica; 24 mica segments were replaced, but as the work was in progress it was found that others were also showing signs of going, and it was agreed that the commutator should be removed and rebuilt. The commutator hub was duly removed, together with all the bars, to the repair shop. After dismantling the commutator the total number of faulty mica segments was found to be 64. This suggests that when a few of the mica segments become faulty, the others follow closely, and it is only a matter of time until they all give out.

Fig. 2 shows another case of an armature going to earth at the front mica vee ring, the beginning of the trouble in this case being a few bad joints in commutator lugs causing pitting of the mica which had then become carbonised.

Many complaints are received of motors throwing oil all over the commutators and brush gears. In two recent cases the commutators and brush gears were in a filthy condition, and on removing the end plates, it was found that the brushes were not properly designed as regards the cutting of the gutters. An oil gutter was cut along the whole length of bush and allowed oil to travel right to the end of the bush to the collar and then on to the brush gear and commutator. The gutters should terminate in a circular gutter about $\frac{1}{8}$ in. from the end, and a hole should be drilled through the bush to meet the circular gutter and allow the oil to drain into the oil well. In the case in question, two grub screw holes were drilled close together right through to the shaft. This, of course, was gross carelessness; the holes should not have been drilled completely through the bush.

Modern Steam Practice.

Recent Developments in the Transvaal Power Stations.

We abstract from the valedictory address of the retiring president of the South African Institution of Engineers, Mr. T. G. Otley, which he read before the annual general meeting of the Institution on June 17th, and of which a report is published in the *Journal* of the Institution, some very interesting details concerning recent developments in the power stations of the Victoria Falls and Transvaal Power Co., Ltd., and also some observations of the author relating to modern steam practice generally in South Africa. He said, *inter alia*:—

Early in 1925 it was realised that a crisis might very easily arise towards the end of the present year and, although the Witbank power station, designed and being built by the Victoria Falls and Transvaal Power Co., Ltd., is scheduled to commence supply at about the end of the year, yet the board of the company took the heroic measure of ordering a new 12,500-kW machine in February for the Rosherville station, to be delivered in June and July, and to be running about the end of August. It is not for me to say whether it was really obligatory on the company to provide any such temporary relief, seeing that the delay to the Witbank scheme was not of its seeking, but the fact remains that the power company shouldered the burden in a generous spirit in order to safeguard the interests of the mining industry and other consumers.

Although additional turbine plant is on order and will have to be steamed, no additional boiler plant has been or will be installed in the existing station. There are 102 boilers installed in the four steam power stations—40 at Rosherville, 24 at Simmerpan, 20 at Vereeniging, and 18 at Brakpan; the numbers steamed over the peak each day are 36, 21, 17, and 16 respectively.

The boilers that are not steaming cannot be considered as immediate spare and available to meet the load, because of cleaning, inspection, &c. Now, 24 of our boilers have been steaming for about 17 years at a load factor of between 70 and 80 per cent., so that, measured by average British conditions, they have steamed the equivalent of 30-35 years' normal life, and to-day they are virtually as good as when installed, and indeed are steaming at higher efficiencies than at any time in the history of the company. The other boilers range from 13 to 14 years of life at the same power factor, and again the efficiency has been maintained, but the most striking thing, from an engineering point of view, is the fact that every boiler steaming on the system is doing very considerably more than the makers' rating; and the makers' guarantees of evaporation were given when burning Witbank district coal of an average calorific value of about 11,600 B.th.u. per lb., whereas to-day we are burning about a million tons per annum of what may be termed low-grade coal of a calorific value varying between 9,600 and 10,000 B.th.u. per lb.

Innumerable trials and experiments were made, and we ultimately concentrated on what we term selective draught. This consists of applying forced draught over a short area towards the front of the chain grate, which not only increases very considerably the furnace temperature and CO_2, but interposes a barrier of pressure between the curtain and the rest of the combustion space of the furnace, so that for about 12-18 in. at the front of the grate next to the curtain there is what virtually amounts to balanced draught. The higher furnace temperature also tends to accelerate ignition, and the majority of our chain grates now run 12 to 14 per cent. faster than the speeds for which they were designed by the makers, and low-volatile and low-value coals can be burnt very efficiently and at a high rate per sq. ft. of grate area. The first experiments were made with air taken from the blast pipes to the Prat ejector nozzles, but it was quickly realised that separate fans for each stoker grate would be justified. The Schlotter blower fan was brought to our notice, and these high-speed and efficient little fans worked in very well indeed for the scheme we had in mind, and at the present time we have about 150 of these running, which enable us to increase the steam capacity of the plant by anything from 15 to 20 per cent., and in certain cases by 30 per cent. more than we were doing before. In certain cases we are also increasing the induced draught and output by applying 150-h.p. motor fans to each of a number of boilers and, by so doing, we hope to increase their steam capacity by about 40 per cent. more than the normal rating. The money has been well spent, and the boiler efficiency is higher to-day than at any time in the history of the company; we have also met the increasing loads without increasing the capacity of the boiler plant, and we anticipate no difficulty in steaming the full capacity of the new machine that is being installed at the Rosherville station.

The principles involved in the "Loffler" system, in which the whole of the transfer of heat from fuel to steam takes place in the feed heater and in the superheater, so that the boiler is not exposed to fire or to the products of combustion is being applied on a commercial scale, and the results will be awaited with the greatest possible interest. The two most interesting features are the generation of low-pressure steam by high-temperature steam, and the very high temperatures to which steam is superheated, *viz.*, up to 930 deg. F., and sometimes to 1,110 deg. F. One must not assume that one can work for long periods at such high temperatures, as the characteristics of steel and alloys of steel are not sufficiently well known to justify confidence in working plant at these temperatures. One of the most interesting expositions of the

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effect of temperature on the strengths of steels is that given in a paper presented by Professors A. L. Mellanby and W. Kerr before the North-East Coast Institution of Engineers in February last (ELECTRICAL REVIEW, March 6, p. 383). They point out that in actual working practice the question is not of how violent may be the death of the material, but rather its length of life under the conditions of actual working.

Modern power stations are becoming complex and expensive affairs. In addition to the ordinary bleeding of the turbine to heat the condensate, steam is being returned to special boilers and re-heated; in other words, the steam is being superheated between stages to increase the average temperature through the machine. It is obvious that this ought not to be done unless it shows a financial return on the additional capital involved, but it is not unlikely that, instead of the steam being returned to special boilers, it will be passed through simple heaters utilising the high-pressure and high-temperature steam, or part of it, to re-heat the lower pressure steam on the counter-current principle, the efficiency of transfer being very high, and on the face of things it would appear that the capital cost will be very considerably less.

Naturally, a point must arise where this must end, as it becomes increasingly difficult to obtain the ultimate 1 or 2 per cent., and the cost of doing so is becoming prohibitive. The metallurgist and the steel manufacturer have played a big part in the progress that has been made, and units of 40,000 to 50,000 kW in one cylinder are in service, and there are prospects that units of 100,000 kW, or even more, may be designed.

The size of boiler units has also increased in an even more remarkable manner, but no serious or difficult engineering problems have been involved, as the output of the boiler depends only upon the extension of its heating surface.

Why should it not be practicable to have boiler units of 500,000 lb. capacity, three boilers steaming and one in reserve for a power station of three running turbines, plus one spare? Until quite recently a boiler of 70,000 lb. evaporation per hour was considered a large unit, and there are relatively few boilers in the world to-day of a capacity greater than 100,000 lb. evaporation per hour, but there is no good reason why one boiler per turbine should not be adopted, except, perhaps, that a boiler which is out of commission and cold requires a longer time to get up steam than is required to run up a turbine and its auxiliaries on to load, and should anything happen to a steaming boiler the load would be curtailed.

It is well known among engineers connected with the power industry that capital costs are the biggest factor in production on a large scale, and that the steam generating plant of a power station involves the highest capital cost and also the highest maintenance, but with the advent of large boiler units the capital cost per kWh of production will be enormously reduced not only on account of the boilers, but of the steam pipe arrangements, smaller and simpler buildings, coal bunkers and auxiliaries, and, in passing, I would remark that in the present power-station design the cost of steam, feed-water, and other pipes is becoming a very large factor. In my opinion too much money is, in many cases, being spent on refinements to obtain a high thermal efficiency.

A Novel Air-Break Switch.

Operation in Severe Weather.

ACCORDING to the *Electrical World*, the Railway and Industrial Engineering Co., of Greensburg, Pa., has recently made a 220-kV air-break switch for use on overhead transmission lines. A rotating tubular blade is used, which is claimed to embody

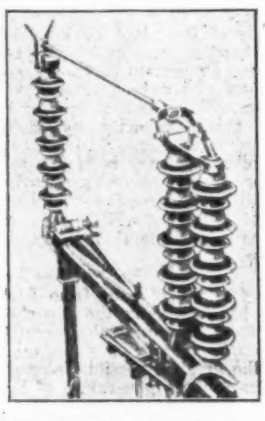


Fig. 1.—Model of Rotating Switch, Showing Constructional Details.

the essentials necessary to produce a reliable mechanism to meet severe weather conditions. An illustration of a model of this switch showing the details of construction is reproduced in fig. 1. The contact end of the blade is provided with a hollow flat end or "beaver-tail" of aluminium bronze 4 in. wide, 1¼ in. thick, and about 5 in. long, with a shank pressed into and riveted to the end of the tubular copper blade 2 in. in outside diameter. In the closed position of the switch this "beaver-tail" is jammed between the tubular copper jaws with a total contact pressure of 400 lb.

Fig. 2 shows the switch in the closed position; at open position the switch blade is perpendicular.

In opening the switch the blade is first rotated through an angle of 60 deg., thereby releasing the contact pressure and breaking out the ice before the blade is called upon to lift. This rotation of the blade is positive, being produced by the first 30 deg. rotation of the rotating insulator at the back end of the switch, the blade being subsequently opened to 7½ deg.

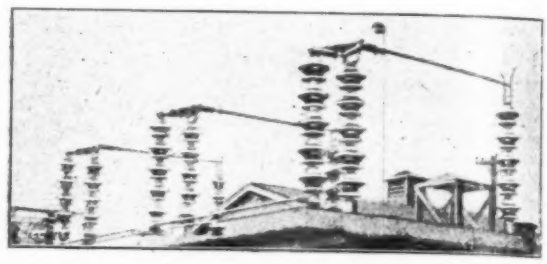


Fig. 2.—Rotating Switches with Blades in Closed Position.

beyond centre by the final 60 deg. rotation of the insulator. The advantage of releasing all pressure at the jaw is very evident when it is realised that the blade is 10 ft. 8 in. between the hinge and the centre of the jaw. If the usual jaw friction and ice locking had to be contended with, the strains on the insulators would be excessive.

The design of the jaw contact is distinctly novel and has been the subject of some speculation. It was thought that the line contact produced would cause excessive heating and wear, but tests have shown that this contact will carry from 800 to 1,000 A without exceeding a temperature rise of 30 deg. C. Wear is compensated by facing the 1¼-in. outside diameter tubular copper jaws with cast aluminium-bronze shoes having 1¾-in. faces.

All the essential mechanical parts of the switch above the insulators are of high-tensile aluminium-bronze, having also a high elongation and great resistance to shock. The blade has a double reinforcing of seamless steel, the first extending approximately 80 per cent. of the length from the hinge end and the second being within it.

In a recent test to determine the mechanical fitness of the switch for duty on 220-kV systems, it was operated continuously for 24 hours, the controls to the motor contactors being equipped with a special relay which started the switch in the opposite direction a few seconds after an operation was completed. During this period a cycle counter attached to the switch indicated 3,186 complete openings and closings and a d.c. Wh meter for the 1-h.p. motor showed a consumption of 13.5 kWh, 4.17 Wh per cycle of operation.

The prevailing temperature during the test averaged about 12 deg C. below zero. Before starting the test the switch was sprayed to form artificial sleet to a thickness of ¼ to ½ in. Before the completion of the test the motor mechanism and the auxiliary switch were sprayed from a hose nozzle and the cases were found to be tight. No part of the switch or mechanism failed, with the exception of the flexible leads to the rotating blade. The blade contacts showed a maximum wear of 0.005 in. without lubrication, and on the aluminium-bronze shoes on the tubular jaws only a slight depression was produced.

Norwegian Water Power.—A committee of French engineers made an inspection of Norwegian waterfalls and hydro-electric works in the last week in July and subsequently gave to the Oslo newspapers an account of the impressions which they had formed. In the opinion of the engineers the Norwegian water powers possess extraordinarily large possibilities of being regulated; they are capable of being utilised all the year round, whereas in France it is only possible to rely upon four months' working, at the end of which steam power has to be used. If, therefore, the Norwegian industries adopt the most modern methods it is considered that the country will have unique industrial possibilities. A beginning has already been made at the Rjukan works, where the Haber ammonia process is being introduced. At Odda it is proposed to transform the process at the cyanamide works where, among other things, liquid air is to be produced according to the Claude process. As to the future of the aluminium industry, the French engineers are reported to have stated that Norway must be considered to occupy an important position in this respect, but the prices are so high that aluminium is not used in the big industries as much as is desirable. It was added that the French import duties stand in the way of the export of manufactures of aluminium from Norway.

Business Notes.

Commercial and Industrial Developments, Business Changes, Trade Opportunities, New Publicity Literature, Liquidations and Failures.

Lead Market Report.—Messrs. James Forster & Co. reported on August 15th: "Closing prices yesterday were £37 12s. 6d. for August and £36 6s. 3d. for November, a fall on the week of 6s. 3d. a ton for forward, with August unchanged. The expected set-back, after a continuous advance since July 27th of nearly £3 a ton, came at the beginning of this week, but a firm tone set in again and there was a recovery. The close is firm at £37 12s. 6d. for August, £37 2s. 6d. for September, £36 12s. 6d. for October, and £36 6s. 3d. for November. According to the Board of Trade returns the imports of lead during July into the U.K. created a record, no less than 27,367 tons being imported. The balance of imports over exports, *i.e.*, 25,551 tons, went straight into consumption and yet at the end of July a shortage developed, which indicates what a tremendous consumption is taking place. This month arrivals are considerably less, only about 9,000 tons being imported up to the 13th inst., and the position is getting more acute every day. Although the current price of lead is certainly very high, everything points to a further advance in values, until either consumption is checked, or production is increased to such an extent as to satisfy the world's demand and leave a surplus."

Shannon Contract Signed.—The contract between the Irish Free State Government and the Siemens-Schuckertwerke for the carrying out of the Shannon hydro-electric scheme was signed last week. A correspondent of *The Times* reports that it is intended to commence the work next month, the first stage being the construction of a canal from O'Brien's Bridge to Ardnacrusha, which is to be the head race of the power station. It is said that the contract is valued at 2½ millions sterling, but does not provide for the distribution works for which a further contract will be necessary at a later date. There is still uncertainty as to the methods which will be adopted to raise the necessary funds.

It is expected that the work will occupy three years and in the meantime the Government is to undertake an intensive educational campaign to acquaint prospective consumers with the advantages of electricity—especially in agricultural applications.

The Birmingham Building Trades Exhibition.—The Birmingham Electric Supply Department informs us that it has taken space for an exhibit of electrical appliances of all kinds at the Building and Allied Trades Exhibition which is to be held at Bingley Hall, Birmingham, from September 7th to 19th. Moreover, in conjunction with local electrical manufacturers and contractors, four lectures by well-known experts, with practical demonstrations, have been arranged. The lectures will be given by Messrs. J. W. Beauchamp and V. W. Dale, of the British Electrical Development Association, and Messrs. W. E. Bush, W. J. Jones, and R. C. Hawkins, of the E.L.M.A. Lighting Service Bureau. At the same exhibition the Yorkshire Copper Works, Ltd., will show copper tubes for hot and cold water systems.

Delagoa Bay Strike.—The employés of the Delagoa Bay Development Corporation, which provides the town's tramway, lighting, and water services, struck work last week, causing much inconvenience. The trouble was due to grievances in connection with currency. It was expected that the Government would intervene.—*Reuter* (Lourenço Marques).

Boiler Contracts. — The Stirling Boiler Co., Ltd., is at present erecting two 40,000-lb. boilers at the Bedford Corporation's electricity works. Other orders recently secured include a 30,000-lb. unit for the Kettering municipal electricity undertaking, two 50,000-lb. units for the Northampton Electric Light & Power Co., Ltd., and a 45,000-lb. boiler for the Hammersmith Borough Council.

"Exide" Battery Service.—The Chloride Electrical Storage Co., Ltd., has issued to its "Exide" service agents a chart which shows, among other things, the appropriate batteries for all makes of automobiles.

Italy's Foreign Electrical Trade.—A report upon the foreign trade of Italy during the first quarter of the current year shows that the value of electrical imports was more than double that of exports. The actual figures were: Imports 11,180 quintals, valued at 25,245,770 lire (as against 17,984,200 lire in January-March, 1924), and exports 7,407 quintals, valued at 11,103,239 lire (as against 10,743,540 lire). The principal item in both divisions was generators and motors, the exports at 6,501,738 lire being slightly higher than the imports. Electric meters to the value of 4,799,148 lire were imported; the value of imported radio apparatus is shown as 4,147,993 lire; and telegraph and telephone apparatus as 1,872,113 lire. The second largest item in the export list was magnetos, valued at 887,561 lire. In an analysis of the sources of imported electrical goods, Germany occupies the first place as in the previous year. France wrested the second place from Hungary, while Great Britain remained in the sixth position. The strong position of Germany in this market can be judged from the fact that her exports to Italy represented about 60 per cent. of the total, while the French share (the second highest) was only about 11 per cent.

Chinese Notes. — The *Chinese Economic Bulletin* reports that the Chapei Water & Electric Supply Co., Shanghai, has increased its capital by $680,000 to $2,000,000, for the erection of a new water plant.

A group of local capitalists in Kaoyu (Kiangsu province) has decided to install a telephone service in the city. A sum of $6,000 has been raised to meet preliminary expenses.

The employment of automatic telephones in China has made great headway both for public and private purposes. The largest automatic exchange is that operated by the South Manchurian Railway Co. at Dairen. This exchange, which was provided by the Automatic Telephone Mfg. Co., Ltd., is equipped for 4,800 lines, but is capable of extension to 10,000 lines. There is also a 3,000-line exchange at Harbin, and it is expected that Tientsin will be provided with automatic telephones at an early date. Although most of the work has been done by the British it is said that a small number of German automatic telephones have been installed at Tsinan.

Trade Announcements. — A firm styled the STONEHOUSE RADIO SUPPLIES has opened a radio shop at 54, Union Street, Stonehouse, Plymouth.

A new electrical department has been opened by the CLECKHEATON ENGINEERING & MOTOR CO., LTD., of Bradford Road, Cleckheaton.

Owing to the increase in their export business in the London area, MESSRS. JOHNSON & PHILLIPS, LTD., have transferred their London Export Sales Branch, under Mr. J. Horne, from their main London offices at 12, Union Court, Old Broad Street, to new and more extensive accommodation at 23-24 Wormwood Chambers, Wormwood Street, E.C.2. The telephone numbers remain the same, *i.e.*, Central 2207 and 178.

The business of the "Cantie" Switch Co., Ltd., has been purchased by BROOKHIRST SWITCHGEAR, LTD., but will continue to be carried on under the present name and from the same address—Leighton Street, Nottingham. It is being arranged that the branch offices and agents of Brookhirst Switchgear, Ltd., shall represent the "Cantie" Company.

The address of Mr. ARTHUR H. SPEARING is now 3 & 4, Clement's Inn, W.C.2. Telegrams: "Spearartha, Estrand, London"; telephone: Holborn 3136-38.

Messrs. F. W. BERK & Co., LTD., are removing, on August 24th, to larger premises at 106, Fenchurch Street, E.C.3. The firm's telephone numbers and telegraph address will remain as before.

Our Foreign Trade.—JULY FIGURES.—The Board of Trade returns for July show the following values of electrical imports and exports:—

	July, 1925.	Inc. or dec.	7 months, 1925.
Imports.—	£	£	£
Electrical goods and apparatus	291,087	+ 353	+ 727,566
Machinery	1,106,139	+173,004	+ 968,156
(Electrical machinery) ...	93,401	+ 13,128	+ 12,146
Exports.—			
Electrical goods and apparatus	863,952	+ 18,730	+1,456,983
Machinery	3,910,612	+ 30,904	+2,801,797
(Electrical machinery) ...	435,799	– 4,152	+ 492,681
Re-exports.—			
Electrical goods and apparatus	22,785	+ 8,117	+ 63,722
Machinery	148,257	+ 32,145	+ 139,541
(Electrical machinery) ...	4,886	+ 66	– 20,559

Receiver Appointed.—EGO ENGINEERING CO., LTD., Regent Street, W.—Mr. Wm. Osborne, of Messrs. Corfield & Cripwell, Balfour House, Finsbury Pavement, E.C.2, informs us that he was appointed receiver on August 5th on behalf of the debenture holder in this matter. The debenture issue amounts to £800, plus interest, and, judging from the report of the directors of the company as to the value of the assets, he does not anticipate that there will be a sufficient sum realised even to meet the debenture holder's claim.

The Stinnes Concern.—According to the latest German estimates the liabilities of the Stinnes undertakings amount to no less than £9,000,000. Negotiations are proceeding for the sale of the trust's properties, including newspapers and mines. With regard to the latter it is reported that the Rhenish Westphalian Electricity Works is contemplating the purchase of the Mathias Stinnes coal mines.

French Radio Apparatus Tariff.—According to a recent decision of the French Customs authorities radio apparatus is to be classed as "Electrotechnical apparatus" for the purpose of import duty (No. 524 *bis* in the tariff list).

Patent Application.—The Automatic Telephone Manufacturing Co., Ltd., has applied for an extension of the periods of patents Nos. 1,298, 1,418, 1,420, 1,422, 7,876 and 7,877, all of 1910. The application will be heard by Mr. Justice Tomlin on October 13th in London.

Russia's Credit Requirements.—The Manchester correspondent of the *Financial Times* says that the Russian delegation which recently visited the city in connection with the projected purchase of textile machinery to the value of £5,000,000, insisted that orders could only be placed if the manufacturers were willing to allow long-term credits.

British-Dutch Valve Agreement.—An agreement has been entered into by the Mullard Radio Valve Co., Ltd., and Phillips Glowlampworks, Ltd., of Holland, whereby the former company gains the use of all the Phillips valve patents, machinery designs, and technical knowledge, with a view to manufacturing the Dutch firm's valves in this country. Messrs. Phillips have agreed to cease importing valves into Great Britain and Ireland, a matter of some magnitude as they have been by far the largest suppliers of foreign valves.

Bankruptcy Proceedings.—J. S. Yeomans, 11, Hill View Terrace, Chapel Allerton, Leeds, electrician.—The receiving order herein was made recently on debtor's own petition. The statement of affairs showed liabilities of £213, against assets of £17. The first meeting of the creditors was held on July 27th, at the Official Receiver's Office, 24, Bond Street, Leeds, when the case, being a summary one, was left in the hands of the Official Receiver as trustee. The following are creditors:—

	£		£
Churton, T. H.	33	Metcalf, —	22
Crowther, N.	23	North Electrical Co.	37
Electric Lamp Factors	23		

V. G. Baines, electrician, 2, West Street, Wellingborough.—Last day for receipt of proofs for dividend, August 25th. Trustee, Mr. D. Helliar, Official Receiver, The Parade, Northampton.

J. Isherwood, wireless and photographic dealer, 91, Lee Lane, Horwich.—Last day for receipt of proofs for dividend, August 29th. Trustee, Mr. J. G. Gibson, Official Receiver, Byrom Street, Manchester.

J. S. McLeod (trading as McLeod Bros., at Bolton, and, with a partner, as McCload Bros., at Horwich), radio and electrical engineer, 189, Blackburn Road, Bolton.—Last day for receipt of proofs for dividend, August 31st. Trustee, Mr. A. T. Eaves, C.A., 47, Mosley Street, Manchester.

H. Fildes, electrical engineer's superintendent, 108, Monton Road, Eccles.—Last day for receipt of proofs for dividend, August 29th. Trustee, Mr. J. G. Gibson, Official Receiver, Byrom Street, Manchester.

J. F. Lyons, electrical engineer, 25, Palmerston Street, and Front Street, Consett, Durham.—First and final dividend of 1s. 8½d. in the £, payable August 27th, at the Official Receiver's office, Pearl Buildings, 4, Northumberland Street, Newcastle-upon-Tyne.

G. W. Tempest, 12, Sandhurst Road, Stockport, trading as the Northern Radio Co. and the General Wireless Trading Co., at Manchester, radio and telephone engineer.—Trustee, Mr. A. Yearsley, 27, Brazennose Street, Manchester, appointed August 11th.

W. R. J. White, electrical agent, 29, Great Pulteney Street, W.1.—Trustee, Mr. D. Williams, Official Receiver, Carey Street, W.C., released July 27th.

J. Benson, lately carrying on business as an electrical engineer at 2a, Wade Street, Leeds.—Receiving order made August 7th on debtor's own petition.

Roberts & Co., electrical engineers, 61, Old Town Street, Plymouth, and at East Looe, Cornwall.—Receiving order made August 10th on a creditor's petition.

Company Liquidations.—Roderick Electric Supplies Co., Ltd., Theobald's Road, W.C., and St. Mary Street, Swansea.—The creditors interested herein were called together recently at the offices of Mr. W. H. Cork, 19, Eastcheap, E.C., who occupied the chair, and reported that he had been appointed to act as the liquidator in the voluntary liquidation of the company. The statement of affairs presented showed liabilities of £1,669, of which £1,468 was due to the trade. The assets were estimated to realise £372, from which had to be deducted £179 for preferential claims, leaving net assets of £193, or a deficiency of £1,476. The company was incorporated as a private limited liability concern in July, 1923, to take over a business which was established by Mr. W. A. Roderick in 1914. The company had a nominal capital of £2,500, and there had been issued 2,272 ordinary shares of £1 each, and 1,000 deferred shares of 1s. each. The vendor was issued fully paid shares as the consideration for the assets. When the company was formed there were liabilities of £1,690, and assets valued at £3,010. A balance sheet was prepared in June, 1924, which showed liabilities to the trade of £2,302, while £137 was owing to the bank. The trading for the period showed a loss of £679, the turnover being £8,112. The deficiency as regarded the shareholders was £3,797, and that figure was accounted for by the depreciation written off the assets in the statement of affairs and the losses on the trading. It was estimated that since July, 1924, there had been a loss of £1,114. Mr. Cork stated that he had continued trading since his appointment as liquidator. He had advertised the businesses for sale, and there was a possibility of something being achieved in that direction, although no definite offers had yet been received. Failing a sale within a reasonable time the business would have to be closed down. Mr. W. A. Roderick said that the large loss had been brought about by the absolute stagnation of business. He thought that the business could be made a success, as there were good contracts which it was anticipated the company would receive. Mr. Cork said that he did not think there was very much in the contracts from the point of view of profits to be earned. The creditors might have been called together some time ago, but apart from that there was nothing to complain about. The books had been well kept. It was resolved to confirm the voluntary liquidation of the company, with Mr. Cork as liquidator, whilst an advisory committee of three of the principal creditors was also appointed. The following are among the creditors:—

	£		£
Cable Accessories Co., Ltd. ...	123	Kodak, Ltd.	77
Credenda Conduits Co., Ltd. ...	68	Morgan Bros.	36
Dorman & Smith, Ltd.	27	Napier-Kimber, Ltd.	40
S. Dawson & Co.	53	Ruse, John	29
Dwyer, P. L.	30	Sloan Electrical Co.	34
Edison Swan Electric Co., Ltd.	45	Swansea Corporation	44
Electric Lamp Factors	28	Siemens & English Electric Lamp	
Aster Engineering Co.	39	Co., Ltd.	71
General Electric Co., Ltd. ...	102	Wesley Evans, J.	105
Hay, G. R.	20	West End Electric Co.	30
Jackson Electric Stove Co., Ltd.	29		

E.S. Co., Ltd., electrical and wireless dealers, 233, Tottenham Court Road, W.—A meeting of the creditors of the above was held on August 14th. The chair was occupied by Mr. B. A. Smith, receiver for the debenture holders and liquidator in the voluntary liquidation of the company. A statement of affairs had previously been circulated which showed net assets of £17,764. There were first and second debentures for £34,147. The deficiency as regarded the debenture holders was £16,382, and as regarded the creditors £37,023. The chairman stated that he was appointed as receiver for the debenture holders on June 26th last, and on July 27th the company went into voluntary liquidation. The company had been carrying on business for a good many years, it having been registered in February, 1915. It took over a going concern, but the original shares issued had changed hands. With regard to the recent trading of the company, during the half-year to June, 1921, there was a loss of about £11,000, largely due to a writing down of the stock. During the two following years there were considerable losses, but during the six months to December, 1923, there was a profit of £400, apart from debenture interest. During the half-year to June, 1924, there was a trading loss of £700, and in the next six months there was a small profit. That profit, however, was turned into a loss of £123 by the writing off of bad debts incurred in the previous half-year. There was every reason to hope that by reducing the expenses the company could carry on successfully. During the current year, however, the sales had fallen off considerably. Two creditors issued writs against the company and that precipitated the appointment of a receiver. At that time there were some hopes of a re-organisation of the company taking place, but when the accounts were prepared it was thought that any such venture was hopeless. The issued capital of the company was £5,600, of which £4,703 was issued for cash. As far as he knew £898 worth of shares were issued for a consideration other than cash. He believed those shares were allotted to the vendor in respect of the goodwill of the business taken over. In reply to a question, the chairman said that there was no limitation to the company's borrowing powers.

Mr. Houstoun said the position was that in 1921 the company lost £11,000, and shortly afterwards it was insolvent. He inquired when the second debentures were issued, and what the consideration was. The chairman replied that the first debentures and interest were for £12,397, whilst the second debentures and interest totalled £21,749. All of the debentures were issued for cash. The second debentures were issued in July, 1922. There might have been a debit balance on the profit and loss account when the second debentures were issued. Rather more than £21,000 in fresh money had been paid into the company since that date. All the money obtained was used in the ordinary course of trading.

Mr. Kinnaird, of Messrs. Stanley Evans & Co., the solicitors to the company, pointed out that if the liquidation had taken place at the end of last year the debenture holders would have received 20s. in the £. The company, however, continued, the liabilities to the trade had been reduced by £15,000, and the second debenture holders, including the two directors, could not expect to receive 10s. in the £.

The chairman stated that he was carrying on the business and disposing of the stock at market prices.

Mr. Houstoun mentioned that a petition had been presented for the compulsory liquidation of the company. He proposed a resolution to the effect that the voluntary liquidation should not be confirmed, and this was carried.

Western Engineering Co., Ltd., electrical and mechanical engineers, Liverpool. In voluntary liquidation. The following are creditors:—

	£		£
Downes & Davies	85	Johnson, Clapham & Mor...	
Ellis, W.	47	Ltd.	100
General Electric Co., Ltd. ...	930	Murray, J. A.	184
W. T. Henley's Telegraph		Perrin, Hughes & Co., Ltd.	50
Works Co., Ltd.	20	Rowe Bros. & Co., Ltd. ...	67
		Smith & Cookson	132

Robins Wholesale Electrical & Wireless Co., Ltd.—Winding up voluntarily. Meeting of creditors held August 19th at the offices of the liquidator, Mr. S. E. Clutterbuck, 31, Queen Street, Cardiff.

Western Wireless Telephones, Ltd.—Winding up voluntarily. Meeting, August 26th, at the office of the liquidator, Mr. W. J. Birch Kempton, 20, North John Street, Liverpool. Particulars of claims were to be sent in by August 19th.

RADIECO, LTD.—A meeting is called for September 11th at the offices of Messrs. Corfield & Cripwell, Balfour House, Finsbury Pavement, E.C.2, to hear an account of the winding-up from the liquidators, Messrs. C. L. Thornton Duff and W. A. J. Osborne.

MOSELEY INSTALLATIONS, LTD.—Winding up voluntarily. Liquidator, Mr. C. E. Cowney, 55, Temple Row, Birmingham. A meeting of creditors was to be held on Wednesday last.

THE WATERLOO WIRELESS CO., LTD.—A meeting of members is called for September 16th at A22, Queen Insurance Buildings, 10, Dale Street, Liverpool, to hear an account of the winding up from the liquidator, Mr. R. R. Bailey.

ASSOCIATED ELECTRIC TRADERS, LTD.—Mr. G. D. Pepys, Official Receiver and liquidator of this company, 33, Carey Street, W.C.2, states that the liabilities amount to £5,720, and the estimated assets to £200. It is proposed to pay a first and final dividend, and proofs of debts must reach the liquidator by September 2nd.

Dissolutions of Partnership.—DAFFERN & EDWARDS, electrical heating and sanitary engineers, &c., 10, High Town, Hereford.—Messrs. W. F. Edwards and H. J. Darlow have dissolved partnership. Debts will be attended to and the business carried on by Mr. Edwards.

RALPH NANCE, electrical and consulting engineers, &c., 5, Stuart Street, Bute Docks, Cardiff.—Messrs. R. V. and H. C. Nance have dissolved partnership. Mr. R. V. Nance will attend to debts.

THE NORMAN BAYNTON CO., sellers of electric lamps and accessories, 26, Rathbone Place, Oxford Street, W.—Messrs. C. N. Bradnock and L. S. B. Williams have dissolved partnership. The business will be continued by Mr. Bradnock.

RILEY, RUSSELL & Co., wireless dealers, John Street, Bradford.—Messrs. A. H. Riley and S. A. Russell have dissolved partnership. Mr. Riley will attend to debts.

Private Arrangements.—WILLIAM EDWARDS, trading as Edwards, Sons & Co., electrical and radio dealer, 492, Prescot Road, Old Swan, and 20, Prescot Road, Fairfield, Liverpool.—A meeting of the creditors of the above was held recently, at the offices of Mr. P. S. Booth, accountant and auditor, Liverpool, when a representative of Messrs. Baxendale Bros., Ltd., occupied the chair. A statement of affairs was submitted, which disclosed liabilities of £1,224, of which £1,108 was due to the trade, and there were cash creditors for £117. In addition, there were fully secured creditors for £571, who held security valued at £879, leaving a surplus of £298. The net assets were £1,547, leaving a surplus of £323. It was decided to confirm the deed of assignment already executed in favour of Mr. Booth, while a committee of inspection was also appointed, consisting of the representatives of Messrs. Baxendale Bros., Ltd., Rowe Bros. & Co., Ltd., the General Electric Co., Ltd., Pulford Bros., and Mr. John Airey. The following are creditors :—

	£		£
Baxendale Bros., Ltd.	220	Liverpool Corporation	26
Claremont, Johnson & Co., Ltd.	43	Levy, H., & Son	24
General Electric Co., Ltd. ...	78	Marshall, O. P., & Co., Ltd. ...	31
Holloway, Ltd.	20	Pulford Bros., Ltd.	100
Hamilton & Co., Ltd.	50	Roberts & Co.	20
Longford Insulating Co., Ltd. ...	35	Rowe Bros. & Co., Ltd.	85

Book Notices.—"Electrical Precipitation." By Sir Oliver Lodge, D.Sc., F.R.S. Pp. v+40; figs. 7. London: Humphrey Milford. Price 2s. 6d. net.—This work is a publication in book form of a lecture delivered by the author before the Institute of Physics at the Institution of Electrical Engineers' building, in October last. In the lecture, which was abstracted in the ELECTRICAL REVIEW of November 7th, 1924, the author puts forward a plea for the electrical control of the atmosphere, by assisting natural precipitation artificially. The book is arranged in three parts—natural precipitation, artificial precipitation, and the combination of the two. An appendix is also included, containing some most interesting and useful practical notes on commercial precipitation of dust and fumes.

"The Elimination of Interference from Radio Receiving Apparatus." Air Ministry Publication 1,136. Pp. 8. London: H.M. Stationery Office. Price 2d. net.—With a view to obtaining the best conditions for radio reception, the principles of some of the methods of avoiding interference have been set out, and a summary of 16 possible methods of obtaining relief is given.

"Primer of Costing," by R. J. H. Ryall. Pp. x + 115. London: Sir I. Pitman & Sons, Ltd. Price 5s. net.

"Mercury Arc Rectifiers and Mercury-Vapour Lamps," by J. A. Fleming, M.A., D.Sc., F.R.S. Pp. viii + 100; figs. 44. London: Sir I. Pitman & Sons, Ltd. Price 6s. net.

Catalogues and Lists.—IGRANIC ELECTRIC CO., LTD., 147, Queen Victoria Street, E.C.4.—Pamphlets advertising "Igranic" concert coils and giving reduced prices of honeycomb duolateral coils. Also a chart showing the coils required for the reception of transmissions from British and European stations.

THE HENKERBAK SYNDICATE, LTD., The Hague, Holland.—A pamphlet describing the "Henkerbak" electrical water-heating apparatus.

TOK SWITCHES, LTD., Granville House, Arundel Street, W.C.2.—A blotter bearing a calendar for August advertising "Tok" switches.

MESSRS. FALK, STADELMANN & Co., LTD., 83-87, Farringdon Road, E.C.1.—A three-fold showcard illustrating, in colour, "Efesca" radio components, including headphones, and the "Puravox" loud-speaker.

ELECTRICAL DEVICES, LTD., 18-20, Collingwood Street, Newcastle-on-Tyne.—A comprehensive trade price list of radio apparatus, including complete sets, components, and accessories.

THE GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2.—Catalogue Section W (2) containing illustrated details of the "Magnet" wiring system. Fully priced.

ENGINEERING SUPPLIES, LTD., 235a, Blackfriars Road, S.E.1.—An illustrated and priced catalogue of radio components, including geared coil holders, condensers, transformers, filament resistances, &c.

MESSRS. COLEY & SWINNERTON, LTD., St. John's Square, Wolverhampton.—Two illustrated and priced pamphlets dealing with electric cookers.

THE MIDLAND ELECTRIC MANUFACTURING CO., LTD., Barford Street, Birmingham.—An illustrated and priced folder containing details of "Memrex" ironclad switches designed to comply with the I.E.E. regulations for medium-pressure switchgear.

MR. GEORGE ELLISON, Perry Barr, Birmingham.—List No. 161, containing illustrations, details, and dimensions of totally-enclosed, unit type draw-out switchgear for large capacities.

British Trade Mark Applications.—The following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from August 12th :—

Lightning. No. 459,726. Class 1.—A chemical solution for use in batteries and accumulators. Louis Frederick Ducker, 55, Worple Road, Wimbledon, S.W.19.

Tunion. No. 450,180. Class 9.—Instruments and apparatus for use in wireless telephony. George Turncock, trading as G. Turncock, 41, High Street, Aston, Birmingham.

Astra. No. 448,286. Class 9.—Instruments, apparatus, and contrivances for use in wireless telephony and telegraphy. Charles Teverill Freeman and Frank U. Weldon, trading in co-partnership, 124, Victoria Street, London, S.W.1.

Bess (lettering and design). No. 459,632. Class 8.—Electric batteries and accumulators. William Henry Osborn, trading as the Brighton Electric Supply Stores, 38, Gloucester Road, Brighton.

Radiolys (lettering and design). Class 18. Component parts for wireless receiving sets. Lionel Sidney Alexander, trading as the Wholesale Wireless Co., 103, Farringdon Road, London, E.C.1.

Annual Holidays.—The Gorton and Dukinfield depôts of the Stores Department of the London & North-Eastern Railway will be closed from August 29th to September 14th inclusive. Birkby's works, Liversedge, Yorks., will be closed from Saturday, August 29th, to Sunday, September 7th, inclusive.

Local Exhibitions.—NOTTINGHAM.—An electrical exhibition is to be held in the Drill Hall, Nottingham, from October 8th to 17th next. The arrangements are in the hands of the Electrical Contractors' Association, and the exhibition is receiving the support of the Nottingham Corporation Electricity Committee, the local branch of the E.C.A., and the largest manufacturers in the electrical industry. The exhibition will cover cooking, lighting, heating, power and welding, and its period will coincide with the opening of the Corporation's new power station. The display is being organised by Mr. W. A. Gillott, A.M.I.E.E., and full particulars can be obtained from the secretary of the local branch of the E.C.A., Mr. C. Thompson, Armitage Chambers, Victoria Street, Nottingham.

WAKEFIELD.—The city electrical engineer has been asked to prepare a scheme for an electrical exhibition during the autumn.

YORK.—The Electricity Committee has agreed to take space at the forthcoming Industrial Trades Exhibition, which is to be held in September next, for showing electrical appliances.

MEXBOROUGH.—The Urban Council arranged an electrical exhibition recently, which was opened by Mr. T. Chambers, chairman of the Electricity Committee, and proved very attractive. Well-known firms, as well as the local electrical firms, were the principal exhibitors.

A South Wales Exhibition.—An engineering exhibition organised by the South Wales Institute of Engineers was held at Swansea from August 6th to 15th. A number of leading manufacturers displayed electrical, mining, and metallurgical appliances. The Engineering Department of the University College had an interesting display.

Swiss Import Duties Removed.—It is reported from Zurich that the Swiss Government has recently withdrawn the import restrictions on electric irons and cooking stoves, insulated wires and cables, and incandescent lamps.

Canadian Radio Exhibition.—The Senior Trade Commissioner in Canada (Mr. F. W. Field) reports that the Canadian Exhibition Co., 204, King Street East, Toronto, is holding a radio exhibition at the Windsor Hotel, Montreal, from October 12th to 17th. It is understood that a few exhibit spaces are still available. A copy of the application card for space giving the rules and regulations of the exhibition is available for inspection by interested British firms on application to the Department of Overseas Trade (Room 52), 35, Old Queen Street, S.W.1.

The Moscow Radio Exhibition.—We reported in our last issue that the period of the Radio Exhibition which is being held in Moscow had been extended to September 15th. The Department of Overseas Trade now informs us that a further extension, to November 15th, will be made should the interest shown by foreign firms justify it. Foreign firms may import up to October 1st free of duty any kind of radio material, irrespective of all previous prohibition and are free to sell it after the close of the exhibition. Small articles of any one type may be imported up to the number of twelve, medium sized articles up to six, and large articles up to three. It is understood that amateur receiving sets, for instance, may be imported up to the number of twelve of every different type. The Commercial Secretary at Moscow is of opinion that this is a favourable opportunity for United Kingdom radio firms to introduce their wares to Russia. Although import on a large scale is not likely to be allowed after the exhibition, it is probable that licences will be issued for the import of specific articles, and the merits of exhibits will decide the destiny of such orders as may be placed abroad. Intending exhibitors should communicate with the Soviet Union Trade Delegation, 49, Moorgate Street, E.C.2, as soon as possible, for the duration of the exhibition depends to some extent upon the number of entrants.

The Australian Radio Market.—A correspondent of *The Times Trade and Engineering Supplement* points out that while, in 1923, Great Britain exported radio apparatus to the value of £35,100 to Australia, the United States exported £46,000 worth, and in 1924, due to the abolition of restrictions, the value of American apparatus imported rose to £210,500. The Australian market is big and comparatively undeveloped, and the prospects are favourable, particularly as the Federal Government proposes to reduce the fee for receiving licences. There are at present broadcasting stations in Sydney, Melbourne, and Perth, while a fourth is to be opened in Brisbane.

Radio Patents in Austria.—A warning has lately been issued by the Siemens & Halske Co., of Vienna, against infringement of the "Telefunken" patents in Austria, which are claimed to cover reaction couplings, metal-sealed transformers, amplifying valves for loud-speaker reception, frame aerials, and high- and low-frequency amplifiers.

New Canadian Companies.—Among the recently-formed Canadian companies are the following: The Lighting Company of Ontario, Ltd., capital $25,000, for the manufacture of electrical machinery and appliances; the Chute-à-Caron Power Co., Ltd., to develop the power of the Chute-à-Caron Falls, Quebec; and the Portneuf Power Co., capital $1,000,000, which is to re-build a destroyed dam and supply power in the Portneuf, Quebec, district.

New Belgian Company.—La Compagnie Continentale "Trialmo" is the name of a new company which has lately been formed in Brussels with a capital of 200,000 fr., to manufacture radio apparatus.

New French Company.—A new company has lately been formed in Paris (4, Rue Cambronn) with a capital of 1,700,000 fr. and the title La Société d'Exploitation de la Téléphone Picart et Lebas, to acquire and work the Picart-Lebas telephone patents.

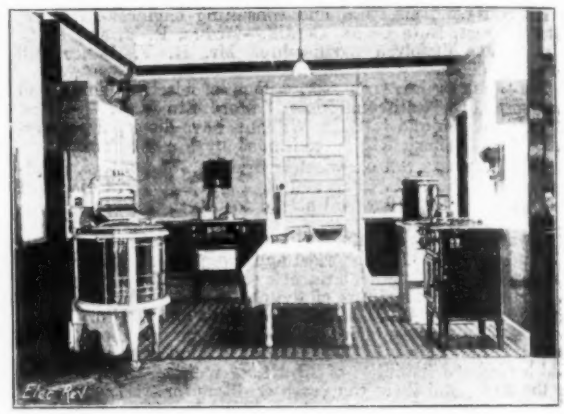
New Indian Companies.—Among the new companies recently formed in connection with electricity supply in India, are the Barisal Electric Industries Co., organised at Barisal, Bengal, with a capital of 500,000 rupees, and the Mangalore Electric Supply Co., at South Kanara, Madras, capital 750,000 rupees.

New Czecho-Slovakian Company.—The "Transforma" Moravian-Slovakian Electrical Construction Co. is the name of a new concern which has lately been formed at Olomoric.

A Report upon Turkey.—Col. H. Woods, O.B.E., the British Commercial Secretary at Constantinople, has recently furnished a report upon the economic and commercial conditions in Turkey (Stationery Office, 1s. 6d.), to the Department of Overseas Trade. There is little of direct electrical interest in the report, but it is stated that the position, generally, is improving and it is thought that the gradual restoration of mutual confidence between Turkey and Europe, once fairly secured, and a consequent improvement in economic legislation would promise a return to more normal conditions. The Director-General of the Customs Administration has announced that he intends to grant every possible facility to trade. In the statistics of foreign trade electrical goods are not shown separately, but under the general heading of "Machinery" it is seen that the imports for the first six months of 1924 were valued at £T2,089,064, as compared with £T1,336,478 for the whole of 1923; the exports were £T54,651, for the first half of 1924 and £T130,863 in 1923. In both the import and export lists Italy occupies the first place, and Great Britain the second. It is pointed out that although Turkey may be a small market she is now one of the few European countries which is obliged to import practically all her manufactured articles, and with a period of peace in which to develop her agricultural and mineral resources, the potential purchasing power of the country should enormously increase. Although the bulk of transactions are for cash with order or against documents, favourable credits are often extended to well-established local firms. The credit given by English and French importers is usually from 30 to 60 days, or 90 days in exceptional cases. German firms have recently commenced to grant credit, but United States firms have so far withheld them. Among the few developments which the report mentions are the construction of a powerful radio station at Angora and the refitting of the Osmanie station near Constantinople, for which tenders have been invited, and the installation of a telephone exchange at Angora, the order having been placed with a Swedish firm. An attempt has been made to introduce broadcasting into Turkey; at present receivers are subject to a Ministry of National Defence permit.

Unemployment.—The number of persons registered as wholly unemployed on August 4th was 1,260,400—an increase of 62,770 on the week, and 180,160 more than in August, 1924. The total included 817,622 men and 194,307 women, the remainder being juveniles.

New Ilford Showrooms.—The Ilford Urban District Council Electricity Supply Department (engineer, Mr. A. H. Shaw) has recently opened new showrooms at Goodmayes. One feature of the new premises is a well arranged kitchen, a view of which appears in the accompanying illustration. Here



The Ilford Council's All-Electric Kitchen.

it will be observed are two patterns of cooker, a combined washing machine and wringer, a water heater, a kettle and a number of other small appliances. The card to the left of the picture indicates that Ilford has a very favourable rate for electric cooking.

The Tokio Underground Railway.—The Tokio correspondent of the Federation of British Industries reports that the Japanese Government has refused to sanction borrowing abroad in connection with the Tokio underground railway scheme, but firms interested in the supply of equipment, &c., should keep in touch with the situation.

American Capital in Italy.—It is reported from Milan that the Banca Commerciale Italiana has sold to the New York banking firm of Blair and Company a large parcel of shares in the Società Idro-Elettrica Piemonte, the American firm in this way getting a first footing in Italy. The Italian company is a trust for the financing of water power development in Upper Italy, which a year ago had a share capital of 120 millions of lire, but has since increased this to 600 millions. It appears that the trust sought to acquire the undertaking of the Negri company of Genoa, in which the Milan Edison company has an interest, but the latter is said to have succeeded in preventing the completion of the transaction, although the shareholders in the Negri company were victorious from a monetary point of view, as they disposed of their shares at high prices to the companies competing for the majority of the shares.

Social Events.—On July 25th the employés of Messrs. A. H. Hunt, Ltd., were the guests of the managing director of the company on a trip to Brighton. The weather was excellent and lunch and tea were provided at the Pavilion, Brighton. There were present at the lunch Messrs. C. H. and A. H. Hunt, F. J. Chamberlain (general manager), and E. A. Baggaley (works manager). On the previous day the company's annual travellers' conference was held at Croydon.

The annual gala and sports of the Chloride Electrical Storage Co., Ltd., were held at Clifton Junction on August 8th. A number of interesting side-shows were arranged.

American Company's Foreign Subsidiary Sold.—An *Exchange Telegraph* message from New York says that the Western Electric Co., which has maintained many foreign branches, and is interested in some factories, particularly in Japan and China, has announced the sale of its foreign subsidiary to the International Telephone and Telegraph Co. The Western Electric had partial ownership of plants in London, Paris, Vienna, Budapest, Barcelona, Milan, Tokio, and Peking. The purchasing company will make improvements, including the extension of its system to the principal cities of Mexico.

German Commerce and Industry in July.—The Commercial Secretary at Berlin (Mr. J. W. F. Thelwall) has forwarded to the Department of Overseas Trade a review, based on the reports of the Prussian Chambers of Commerce, of the commercial and industrial situation in Germany during July. He says that there was no improvement in the general economic situation; on the contrary, the sales crisis became more acute, and affected still further branches of economic life. The reasons for the increasing sale difficulties are to be sought chiefly in the great shortage of capital, with the result that more and more delay takes place in the settlement of accounts. Further, the home market is in many cases influenced by the still deferred final settlement of the tax and Customs legislation. The position of the iron industry became more unfavourable. Scarcely any inland or foreign orders were to be had, and prices everywhere declined further. In view of the unfavourable market situation, the Raw Steel Association decided to restrict the production of raw steel for July by 25 per cent. of the participation figure. Foreign trade was very slack. Under the pressure of French and Belgian competition, export prices receded further, and for German conditions reached an intolerably low level. In the electrotechnical industry a decline in orders, in part considerable, was recorded. This applied specially to foreign orders, as the powers of competition of German firms diminished further. The renewed advance in the price of raw and half-finished products, together with the increase in wages and salaries provided for by an arbitration award, will adversely affect business also in August.

For Sale.—The London and North-Eastern Railway invites offers for the purchase of plant at the power house, Immingham Dock, Lincolnshire. (See our advertisement pages to-day.)

CORRECTION.—We regret that an error occurred in the Hull Corporation's advertisement regarding the disposal of a steam turbo-alternator, which appeared in our last issue (Supplement, p. 26). The phrase "5,500 S.V.T." should have read "550 deg. S.V.T."

Turkish Import Duty Remitted.—The Turkish Government has ordered the exemption from Customs duties of certain medical apparatus, &c. Among them are X-ray equipment and accessories (including dynamos and motors).

Tasmanian Water Power Contract.—It is reported that the Armstrong, Whitworth Pty., Ltd., has received a contract for the extension of the Great Lake hydro-electric scheme, which will increase the capacity from 63,000 to 75,000 h.p., at a cost of £114,000.

Guatemalan Street Railway Concession.—The municipal authorities of the City of Guatemala have intimated their willingness to consider new offers for a street-railway concession.

Lighting and Power Notes.

Accrington.—YEAR'S WORKING.—The accounts of the Corporation electricity undertaking (engineer, Mr. A. W. Clegg) for the year ended March 31st last, show a total income of £76,170, and working expenditure of £39,404: the gross profit was thus £36,774. The previous year's figures were: Income, £74,372; working expenses, £37,863; gross profit, £36,509. To the gross profit was added £155, dividend on war loan, making a total of £36,930. Of this amount, interest and sinking fund charges absorbed £23,293, leaving a net surplus of £13,637 (£12,839), which was carried to appropriation account. A contribution of £2,000 was made to the borough fund. The capital expenditure during the year, which included £19,052 for machinery and £13,643 for mains, amounted to £33,690. The sales of electrical energy increased from 12,192,870 kWh to 13,901,583 kWh, and the average price per kWh obtained fell from 1.459d. to 1.310d. The maximum supply demanded rose from 7,000 to 7,400 kW.

Australia.—VICTORIA.—The Victorian Electricity Commission is considering plans for providing further generating plant to deal with the increasing demand. Preparations are being made for developing hydro-electric power from the Goulburn and its tributaries in the Sugarloaf district. This scheme involves laying down seven small hydro-electric stations. It is estimated that by 1928 the demand will be such that still further power will be required. The Commission is considering three alternatives: Developing the Kiewa hydro-electric scheme in north-eastern Victoria, extending the Yallourn scheme, and extending the Newport power house.—*Electrical Engineer of Australia and New Zealand.*

Blean.—OPPOSITION TO ORDER WITHDRAWN.—With reference to the application of Messrs. Hunt & Sons, of Herne Bay, for an order to supply electricity in the district, the Rural District Council has now consented to withdraw its objection on receiving a satisfactory undertaking that the charges for electricity will not be more than those quoted at the recent inquiry.

Brazil.—ELECTRICAL DEVELOPMENT.—The Government of the State of Rio de Janeiro has signed a contract with the Rio de Janeiro Tramway, Light and Power Co., authorising the supply of electricity to the towns of Campos, Macahe and Sao Joao da Barra.—*Reuter's Trade Service* (Rio de Janeiro).

Continental. — FRANCE. — In order to meet increasing demands the Société Nantaise d'Eclairage et de Force par d'Electricité has recently commenced the erection of a new transmission line between Nantes and Cholet. The line, although designed to work at 120,000 V, will at first be worked at 60,000 V. A feature of the line is that it will cross the river Loire by a single span of 984 ft., and be supported on masts about 310 ft. in height.

STYRIA.—Work has commenced on the construction of two large hydro-electric stations between Bruck-an-der-Mur and Mixnitz, which is expected to occupy three or four years.

SWITZERLAND.—The Nordost-Schweizerischen Kraftwerke, in conjunction with the Motor Columbus Gesellschaft of Baden, has plans in hand for a new hydro-electric station at Niederach-worstadt.

SPAIN.—*Commerce Reports* states that the Hydroelectrica Espanola, which furnishes Madrid with power, reports the production of energy during the year 1924 at 220,000,000 kWh, a considerable increase over the output during 1923. At the end of the year the new installation at the falls of the Jucar River was put into commission; its capacity is 3,200 kW. The new turbo-generator in the central power house of Madrid was completed in October, increasing the total capacity of the company's plants in Madrid to 22,600 kW.

Dartford.—ELECTRICITY SUPPLY.—The West Kent Electric Co., Ltd., has informed the Rural District Council that it is carrying out extensive works in connection with the laying of mains for the supply of electricity to Stone and Swanscombe at an expenditure of over £250,000, and the works are due for completion by the end of 1925. The company added that it was opposing the application for additional powers put forward by Gravesend and Dartford Town Councils, and asked for the Council's support. The Council has decided to oppose the application and to be represented at the inquiry.

Dewsbury.—LOANS SANCTIONED.—The Town Council has received sanction to loans of £2,685 for the supply of electricity in the Shaw Cross and Leeds Road areas, and £1,000 for mains for supply to Thornhill Lees.

East Ham.—YEAR'S WORKING.—The report on the working of the Borough Council's electricity undertaking (engineer, Mr. W. R. Elliott) for the year ended March 31st last, records a total revenue of £87,574, as compared with £81,527 in the preceding year. Working expenses were £61,968, as against £53,509, leaving a gross profit of £25,606 (£28,018); to this was added £8,601, brought forward, and bank interest of £183, making a total of £34,389, which was distributed as follows:—Interest on loans, £4,281; income tax, £3,154; contributions to sinking fund, £5,367; loan repayment, £2,976; contributions to capital expenditure, £9,196; rate relief, £7,918; depreciation and renewals fund, £683; balance carried forward, £815. The capital expenditure during the year amounted to £32,388, the bulk of which was expended on machinery and cables. The sales of electrical energy increased from 5,966,439 to 6,697,884 kWh, and the maximum supply demanded from 3,135 to 3,444 kW. The average price per kWh obtained fell from 3.19d. to 3.028d. During the year two new 1,000-kW motor converters were installed and one of the original 225-kW horizontal steam sets was displaced.

Edinburgh.—EXTENSION OF ELECTRICITY WORKS.—The Town Council has approved the recommendation of the Electricity Committee to extend Portobello power station to meet the increased amount of electricity which will be required in the winter of 1927. The report prepared by Mr. Edwin Seddon, engineer and manager, shows that the building extensions, required to provide for two 25,000-kW sets, are estimated to cost £200,000; one 25,000-kW set, complete with condensing plant, £100,000; pumping plant and cooling water pipework, £10,000; four boilers, complete with mechanical stokers, steel chimneys, &c., £90,000; coal and ash plant, £12,000. The total estimated cost is £434,500, and it was reported at the last Council meeting that the Electricity Commissioners were prepared to sanction the borrowing of £465,120 for the purposes of the electricity undertaking.

PURCHASE OF COOKERS.—On the recommendation of the Electricity Committee, the Town Council has agreed to purchase 100 electric cookers.

Holmfirth.—PURCHASE OF DOMESTIC APPLIANCES.—The Urban District Council is applying for sanction to borrow £1,000 for the purchase of electrical domestic appliances to be let out on hire.

Irish Free State.—CLONMEL (CO. TIPPERARY).—It is expected that the Corporation's electricity scheme will be completed and a supply available at the end of the present month.

SKIBBEREEN (CO. CORK).—At a recent meeting of the Urban District Council it was decided to write to the Skibbereen Electric Lighting Co. to arrange a conference with the Urban Council on the question of an electricity supply for the town.

Ilford.—LOAN.—The Electricity Committee is applying for sanction to borrow £6,700 for the erection and equipment of a sub-station at Gants Hill.

Japan.—TOKIO.—According to *Eastern Engineering*, the city authorities are planning an improved lighting system as a part of the reconstruction programme for Tokio. According to this plan, it is proposed to light 635 miles of thoroughfares with 40,000 lamp standards at a cost of y.2,000,000. The maintenance is estimated at y.600,000 per annum. The main streets will be lighted by 500-watt lamps and the less-frequented thoroughfares by 400- and 300-watt lamps.

London.—Joint Electricity Authority.—The Minister of Labour has given notice that after August 25th he will designate to the Electricity Commissioners, in accordance with the London and Home Counties Electricity District Order, 1925, the employés' organisations having members in the employment of authorised undertakers in the district, in order that the organisations so designated may choose two representatives of persons employed in connection with the supply of electricity in the district to be members of the Joint Authority. Any employés' organisation which is desirous of being considered under the Order should make application to the Minister not later than August 29th on the form provided for the purpose, copies of which may be obtained from the Secretary, Ministry of Labour, Montagu House, Whitehall, London, S.W.1.

Morocco.—Electrical Development.—Considerable development in electrical distribution is taking place in Morocco. The Société de l'Energie du Maroc is now operating three steam turbo-generators at its Roches Noires station in Casablanca. The station is now supplying current at 5,500 V to the Société Marocaine de Distribution, and the company has also erected a 60,000-V transmission line between Casablanca and Rabat. A similar line is being established from the first-named town to Kourrigha, while others are projected between Sidi-el-Aidi and Sidi-Machoil and between Rabat and Kenitra. It is also proposed to extend the electricity supply to the Setfat and Fedhala districts.

Northern Ireland.—Aughnacloy (Co. Tyrone).—The Town Council has considered an offer of Messrs. Curran, Belfast, to introduce electricity for public lighting and has decided to ask for details of the proposed scheme.

North-West Riding Area.—Arising out of newspaper notices of the recent conference of various local authorities in the north-western area of the West Riding (Aire and Calder) Electricity District, convened by the Keighley Corporation, to consider possibilities of joint action for the supply of electricity in the area, the Oxenhope District Council, last week, received a letter from the Yorkshire Electric Power Co., drawing attention to that company's developments in the area and offering proposals jointly with its associated company, the Electrical Distribution of Yorkshire, Ltd. After a lengthy discussion in private, the Council postponed consideration of the matter for a month, with instructions to the Clerk to ascertain from Keighley Corporation in the meantime what its intentions were with regard to Ovenhope.

Oswestry.—Electricity Supply.—The Town Council recently approved a recommendation that the North Wales Power Co. be given authority to erect in the borough a transmission line for a supply of electricity from Ruabon, providing the company satisfied the Council that it would be impracticable to lay the line underground.

Peterborough.—Electricity Extensions.—The Corporation proposes to carry out extensions at the city electricity generating station at a cost of £99,200.

Price Reductions.—Reductions in the charges for electricity have been made or recommended in the following districts:—

Mirfield.—Lighting: From 6d. to 5½d. per kWh. Power, heating and cooking: First 1,000 kWh per quarter from 2½d. to 2d. per kWh; beyond that amount, 1½d.

Dewsbury.—Lighting: Sliding scale, varying from 5d. per kWh for the first 250 kWh per half-year to 4¼d. for over 1,250 kWh; maximum demand system, from 7½d. and 4d. per kWh to 7d. and 3½d. per kWh. Power: Maximum demand system, from 3½d. and 3d. per kWh to 3½d. and ½d. per kWh.

Maidenhead.—Power: From 2½d. to 2d. per kWh.

Tunbridge Wells.—Lighting: From 5½d. to 4½d. per kWh. Power, heating and cooking: From 1½d. to 1d. per kWh. New alternative domestic rate of 18s. per annum for each living room and hall, and 6s. per annum for other rooms, plus ¾d. per kWh for electricity consumed. Extended shop-window lighting with time switch, 1d. per kWh, plus 5s. per quarter for time switch hire.

Rochdale.—Proposed Change-over.—The Corporation has given notice of its intention to apply for consent to change its system of electricity supply from 3-wire d.c. 440 and 220 V to 4-wire a.c., 3-phase, 50 periods, 440 V between phases and 230 V between phase and neutral.

Sheffield.—Mains Extensions.—The Electric Supply Committee has approved extensions of mains for general distribution purposes, at an estimated cost of £24,961, and extensions and works at a cost of £21,667.

South Africa. — Queenstown. — According to the *South African Power Engineer*, the consulting engineer to the Municipal Council, Mr. A. E. Val Davis, has submitted a scheme for the erection of a new power station to take the place of the existing station which is not now capable of dealing with the increasing demand. It is recommended that the new station should contain two new 250-kW steam alternators, and in addition the two 75-kW sets at present in use at the existing station. Two new water-tube boilers, fitted with mechanical stokers, are also proposed. The cost of the proposed extensions is estimated at £29,330, and the remaining value of the present undertaking at £24,862.

Silsden (Yorks.).—Application for Order.—The Urban District Council is applying for an Electricity Order in respect of its area.

Stretford.—New Sub-Stations.—The Electricity Committee is to erect a new sub-station in the neighbourhood of Skerton Road, Old Trafford, to cope with the increasing demand for power in that area, at an estimated cost of £4,000, and a new sub-station in the vicinity of the junction of Warwick and King's Roads to supply the Council's new housing schemes at Gorse Hill, &c., at an estimated cost, including distribution cables and services for the housing scheme, of £5,000.

Tonbridge. — Electricity Order. — The Urban District Council has agreed, subject to obtaining a bulk supply of electricity from Tunbridge Wells, to apply for Fringe Orders to supply electricity to the parishes of Leigh and Hildenborough.

Uruguay.—Hydro-electric Development.—The possibility of developing the hydro-electric resources of the Rio Negro has again received the attention of the National Administrative Council, and it is probable that engineering companies of the world will be requested to submit estimates of charges for making a complete study of the hydro-electric resources of the river and for preparing definite plans and cost figures.—*Commerce Reports.*

Warwickshire.—Electricity Supply.—The *Birmingham Post* states that it is officially announced that the application of the Barford Electric Supply Co., Ltd., for an Order to supply electricity to a number of villages in South Warwickshire has been refused by the Electricity Commissioners. Statutory powers have been given to the Leamington and Warwick Electrical Co., which was the competing applicant.

Whitehaven.—Loans.—The Town Council has applied for sanction to loans amounting to £7,790, made up as follows:—Mains extensions, Arrowthwaite housing site, £3,790; meters, £1,500; services, £2,500.

Tramway and Railway Notes.

Continental.—Bulgaria.—The first electric railway in Bulgaria has recently been completed and put in operation between Sofia and Kniajevo.

East Ham. — Year's Working. — The accounts of the Borough Council's tramway undertaking (manager, Mr. W. R. Elliott) for the year ended March 31st last, show that the total revenue was £81,292, as compared with £78,316 in 1923-24. Operating costs increased from £89,969 to £96,061, leaving a gross deficit of £14,769 (£11,653). After meeting capital charges and special expenditure out of revenue, there was a net deficit of £42,889, as compared with a deficit of £35,673 in the preceding year. The capital expenditure during the year, which included £12,691 for permanent way, amounted to £14,814. The number of passengers carried increased from 15,342,933 to 15,987,284, and the car miles run from 1,483,256 to 1,568,102. The revenue per car mile fell from 12.46d. to 12.33d.

London.—New Oxford Circus Station.—The new booking hall below the street level at Oxford Circus station was opened to the traffic of both the Bakerloo and Central London lines on August 16th. Eight passimeters have been installed.

Manchester.—New Route.—The Corporation is to construct three miles of tramway track along Kingsway.

Rochdale.—Loan.—In connection with the Town Council's share of the purchase price of the Middleton tramways and the cost of linking up with the local system at Sudden, application is being made for sanction to the borrowing of £11,150.

South Africa.—Railway Electrification.—In connection with the electrification of the Natal main line, the position at the end of May, 1925, was as follows:—Four of the five 12,000-kW turbo-generators in the engine room of Colenso power station were in commission, and the erection of generator No. 5 was nearing completion. Five of the eight boilers were in commission, four of the five circulating-water pumps were in operation, and No. 2 station transformer had been placed in service. With the exception of connections to the transformers at Lidgetton, Cedara, and Pietermaritzburg, all work on outdoor sub-stations had been completed, and the connecting of cables in the sub-stations at Nottingham Road, Lidgetton, Cedara, and Pietermaritzburg was proceeding. All work, including the affixing of anti-climbing devices to the towers, had been completed in connection with the erection of the 88,000-V transmission lines between Pietermaritzburg and Glencoe. The erection of 72 electric locomotive units at Pietermaritzburg had been completed, and a further five were in course of erection.—*South African Railways and Harbours Magazine.*

South Shields.—Year's Working.—The report of the general manager and engineer of the Corporation tramway undertaking for the year ended March 31st last records a total income of £83,513, as compared with £82,903 in the preceding year. Working expenses were lower by £562 at £69,456, leaving a gross surplus of £17,056 (£12,884). After providing for capital charges a balance of £1,679 remained. There was, however, a deficit of £3,942 on the motor-omnibus system, the net result for the whole of the undertaking being a deficit of £2,262. The number of passengers carried increased from 18,125,830 to 18,668,095 ('buses 527,195), and the car miles run from 1,214,451 to 1,280,260 ('buses 97,794). The average traffic revenue per car mile increased from 16.08d. to 17.392d.

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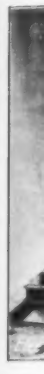

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The Southern Railway Electrification.—III.*

High- and Low-Pressure Cable Systems and Sub-Station Equipment.

THE inauguration of various sections of the extended suburban lines electrification scheme of the Southern Railway marks a new phase in passenger transport facilities south of the River Thames. The first section embraces that portion of the former L.B. & S.C. Railway from Balham to Coulsdon North, and from Selhurst and Norwood Junction to Sutton, a total single track of 82 miles.

Fig. 1.—J. & P. 33,000-V Isolating Switches. Fig. 2.—Cable Troughing along Line; 33,000 V.

Sutton and Coulsdon Extension.—Electricity is delivered by the London Electric Supply Co. at New Cross Gate at 6,700 volts, 25 cycles, single-phase, and is there stepped up to 64,000 volts by two 5,000-kVA transformers, with the centre point earthed. The power is thence transmitted by two single-phase circuits composed of four single-core, 33,000-volt, 0.25 sq. in., lead-covered cables which pass through an isolating cabin at Sydenham, containing cable potheads and isolating switches only, as shown in fig. 1, and terminating at the Gloucester Road Junction (Croydon) B.T.-H. switch cabin, where the pressure is again reduced by G.E.C. transformers to 6,700 V for distribution through an operating switch cabin, feeding the overhead conductors from which the trains collect current by pantographs.

The h.p. cables were supplied and laid by Messrs. Johnson & Phillips, Ltd., in addition to several miles of 0.5 sq. in. concentric 11,000-volt cable, running along the South London line from the Peckham Rye switch cabin, which supplies the previously electrified area, to Battersea Park. This cable at present operates at 6,700 volts and boosts the New Cross-Croydon transmission line, *via* Battersea Park and Balham Junction. Both the high- and medium-pressure cables are laid in wooden troughing, fig. 2, or earthenware ducts securely anchored, while fig. 3 indicates that each joint is bonded by means of a copper strand carried to an earth coil. Fig. 4 is a view of single-phase, 33,000-V joints in a manhole, and fig. 5 shows a van containing a 120,000-volt Delon testing outfit that derives its low-pressure from the S.R. testing car to which it is coupled; the 3-core cable to be seen in the foreground was being used as a condenser.

Fig. 5.—Delon 120,000-V Cable Testing Plant.

Fig. 6.—J. & P. Feeder Cable along Line; 11,000 V.

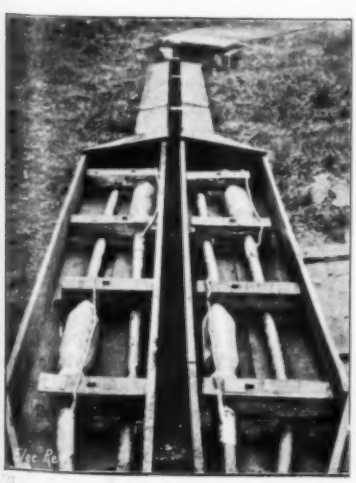

Fig. 3.—Cable Joints and Bonding.

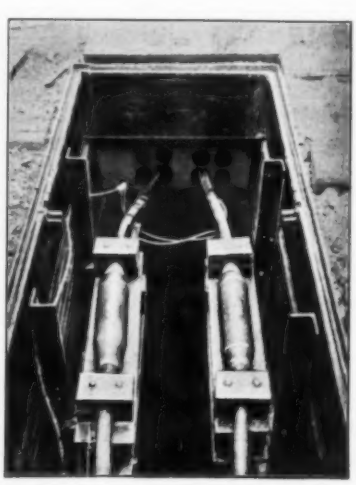

Fig. 4.—Single-phase 33,000-V Cable Joint.

The conversion of the Brighton section has involved the installation of 15 sub-stations, or switch cabins, suitably disposed along the track. The trains are fed from overhead trolley or contact lines, which are sectionalised in accordance with usual practice, each section being supplied from its switch cabin. The switchgear equipment, supplied by the British Thomson-Houston Co., Ltd., is in all instances on similar lines, with modifications depending on the number of tracks supplied, density of traffic, and consequent variation in the chance of heavy overloads or short circuits occurring, importance of section, &c.

*ELEC. REV., April 10th and June 5th, 1925.

In all cases switching is effected by oil-immersed circuit breakers installed in cubicles of brick and stone; oxide-film lightning arresters are provided, and the current transformers are used as through insulators between the top and bottom chambers of the cells.

The sub-stations at Peckham Junction, Tulse Hill, and Gloucester Road will usually have operators in attendance, but the remaining switch cabins will not be attended under normal conditions. The oil circuit breakers are direct hand-operated in some cases and automatically-operated in others, in the latter case transformer-operated trips being provided. All automatic breakers are arranged to ring an alarm bell when

Fig. 7.—Cable Paying-out Train at Chislehurst.

they open, and an indicator informs the attendant which switch has operated in the case of the attended stations, but in the other cases the bell is in the nearest signal cabin. Special interlocking is also provided in connection with the protective equipment to enable testing and repairs to the contact lines, &c., to be carried out in safety.

At Peckham Junction, Tulse Hill, and Gloucester Road reactors are provided; should a fault occur on the contact lines, switches in parallel with the reactors will automatically open so that the contact lines will be fed through the reactors, thus affording a chance for the fault to clear itself by the automatic reduction of the

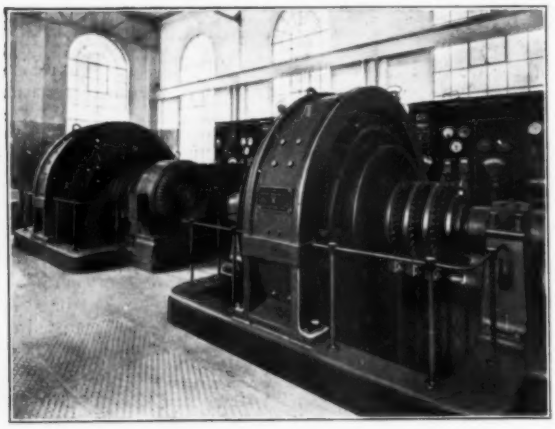

Fig. 8.—G.E.C. Barnehurst Sub-station: A.C. Side.

line voltage. Should this not take place, the oil circuit breaker will automatically open after a time interval.

In addition to various protective features, there is a main "potential block protective system"; the track is divided into sections, all the overhead trolley wires for the up and down tracks for one section being paralleled at both ends on the sub-station bus-bars through the trolley feeder equipment. Each section is fed at one end only through a group feeder equipment, but may at the other end be connected to a similar end of another section through an automatic bus-coupler. The group feeder equipments consist of two oil breakers, one of which short circuits a reactor, which at 6,700 volts will limit a fault current to 1,800 amp. maximum, and it is considered that the minimum fault current which can be dealt with as a fault would be approximately 0.6 times this, or 1,080 amperes. The maximum number of trolley lines in parallel for the purpose of considering fault isolation is four, so that the medium fault current per trolley feeder is a quarter of 1,080 amperes, namely, 270 amps.; this figure is less than the normal rating of the trolley feeders, which are provided with current transformers of 400 :5 amperes ratio. In order to prevent the overload relays from tripping the switch

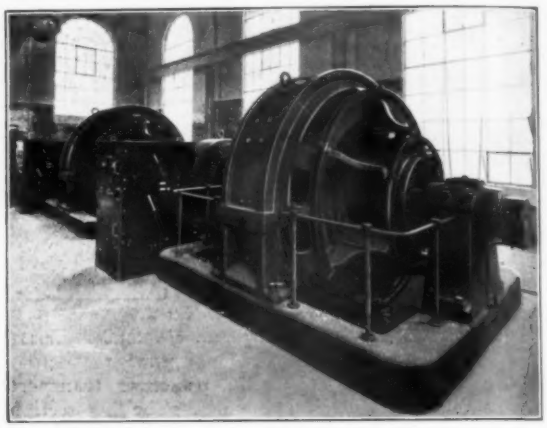

Fig. 9.—D.C. Side of G.E.C. Rotary Converters.

under normal circumstances, "potential block relays" are fitted which short circuit the automatic features of the feeder switches so long as the voltage of the system remains normal, or above, say, 3,800 volts; however, the most important point is that the contacts shall close with the voltage rising from zero to between 4,000 and 4,500 volts, the latter figure being more desirable. The relays are fitted with a dashpot time lag which operates as the contacts open, but not as they are

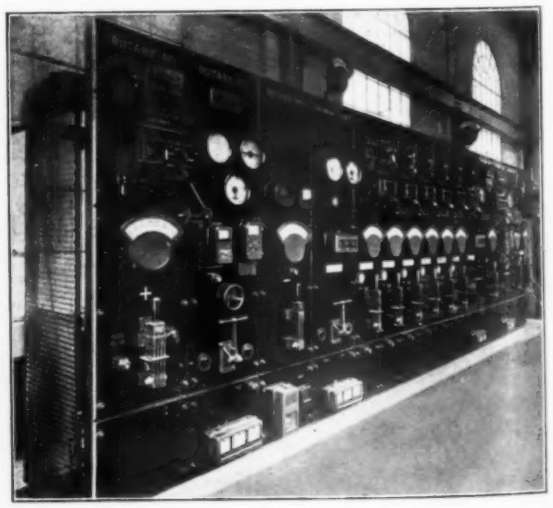

Fig. 10.—Dartford Sub-station; G.E.C. Control Board.

closing, and prevents operation due to momentary overloads opening the reactor switch, and also gives time for the automatic switches on trains to operate before restoring the automatic features of the trolley feeders.

When a fault occurs on a trolley feeder system the reactor switch supplying that section will trip, and if the section is coupled to the adjacent section through an automatic bus-coupler, the setting on this switch should be such that it will trip also. After a short interval due to the induction relay on the group series switch, the latter switch will trip, thus isolating the whole section. With all potential removed, the "potential block"

relays will open and restore the automatic features to the trolley feeder switches. When the operator in the main distributing cabin is warned that a fault has occurred by the opening of the two group feeder switches and the consequent ringing of the alarm bell, he will close the group switch, at the same time short-circuiting its automatic features by means of the pull-button switches.

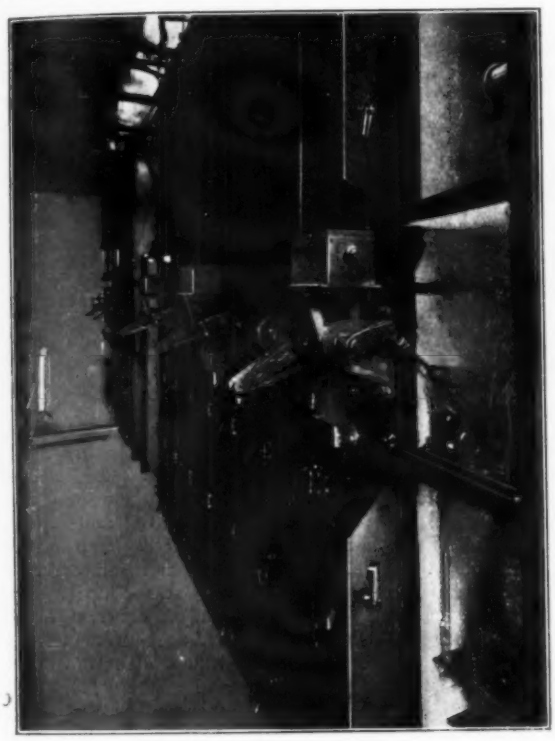

Fig. 11.—G.E.C. Oil Breaker Cubicles.

The S.E. & C. Section.—For the conversion of the South-Eastern and Chatham section, Messrs. Johnson and Phillips are supplying, laying, and jointing over 125 miles of 0.25, 0.15, and 0.1 sq. in. three-core, 11,000-volt, paper-insulated, lead-covered, single wire-armoured and served feeder cable, which is carried on short concrete posts alongside the track, as indicated in fig. 6. For station lighting and signalling purposes the company is installing approximately 55 miles of 0.15, 0.1, 0.0225, and 0.06 sq. in. 3,300-volt concentric cable, paper insulated, lead covered, single wire-armoured and served. The cable contract was placed with Messrs. Johnson & Phillips, Ltd., who sublet 25 per cent. of the manufacture to each of the following firms:—Callender's Cable & Construction Co., Ltd.; the Pirelli-General Cable Works, Ltd.; and Siemens Bros. & Co., Ltd., this S.E. & C.R. cable contract as a whole being claimed to be the largest ever placed in connection with railway electrification. Fig. 7 illustrates a cable paying-out train at the entrance to Chislehurst tunnel; the 11,000-V, 3-core, 0.1 sq. in. cable is shown on two drums weighing 9½ tons gross, each drum carrying 634 yards, and the cable was laid through the tunnel without a joint. In stations, under and over bridges, &c., the cable has been laid in bitumen-filled troughing or drawn into fibre conduit, while for the Deptford Creek crossing a length of submarine cable was used.

On the three routes between Victoria, Holborn Viaduct, St. Paul's and the Crystal Palace and Orpington, *via* Catford, and also Herne Hill, electrical operation commenced on July 12th. The London Electric Supply Corporation, Ltd., delivers electricity from its Deptford generating station to the railway's main sub-station at Lewisham by seven 0.25 sq. in., 11,000-V feeders. Power is thence distributed to 19 sub-stations by duplicate 11,000-V, paper-insulated, lead-covered, and single-wire armoured cables. The switchgear and metering equipment is by the Metropolitan-Vickers Electrical Co., Ltd. The S.E. & C. section is operated on the d.c., 660-volt, third-rail system, and the Lewisham sub-station contains also rotary converters, in addition to three 400-kVA frequency changers, manufactured by the English Electric Co., Ltd., for supplying single-phase, 75-cycle energy for signalling and lighting circuits.

The twenty d.c. sub-stations contain 25-cycle, 11,000-V, 3-phase switchgear and transformers, fifty 1,500-kVA rotary converters, and the necessary 660-V d.c. switchboards. In addition, five of the outlying sub-stations contain duplicate 10-kVA frequency converters for supplying the local signalling circuits. Seven of the sub-stations have been equipped by the English Electric Co., Ltd.; they contain 19 rotary converters, each of 1,500 kW and 500 r.p.m.

The contract entrusted to the General Electric Co., Ltd., included the equipment of eight sub-stations containing 16 converter sets. Each sub-station, one of which is illustrated in figs. 8 to 12, houses two 1,500-kW rotary converters, six-phase, compound-wound, with transformers and a.c. and d.c. switchgear. The G.E.C. also supplied the cable work inside the sub-stations and batteries for the trip coils, &c., complete with rectifiers and switchgear for charging purposes. The specification required that each should withstand a load of 4,500 kW, *i.e.*, 200 per cent. overload for 10 seconds. The machines were actually tested in the presence of the railway company's engineer for 25 seconds on this load, and during the preliminary trial the load was increased to 11,000 amperes without severe sparking, which represents an actual load of over 7,000 kW, and the following efficiency results were

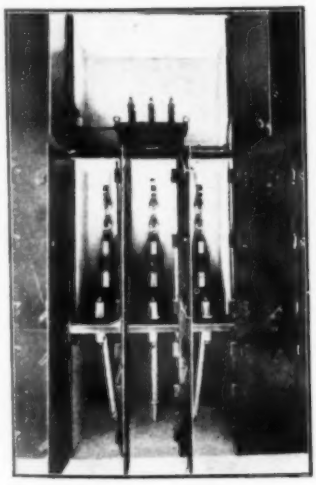

Fig. 12.—Instrument Transformers in Stonework Cells.

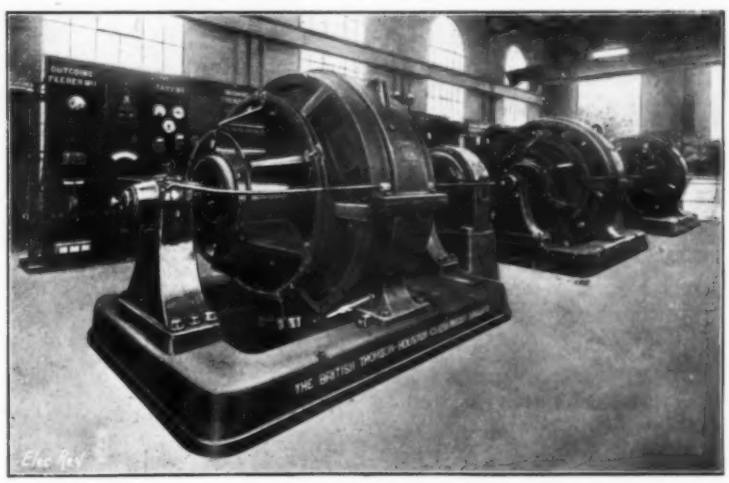

Fig. 13.—D.C. Ends of B.T.-H. Rotaries; Catford Bridge Sub-station.

obtained on test:—Efficiency at full load, 96.26 per cent., and at half load 94.65 per cent. As the load on traction rotaries necessarily varies, it is of importance that their efficiency at half load should be high. The converters operate in conjunction with self-synchronising gear.

The starting pillars (fig. 8) are mounted on the floor close to the rotaries, and in place of the usual open type of panel all the apparatus is enclosed in a black enamelled steel-plate pillar with hinged doors. The switches are provided with external handles, and the synchronising choke coils are mounted in the basement below. The e.h.p. switchgear is in moulded-stone cubicles in the basement, with operating mechanism and instruments mounted on panels to form an integral portion of the l.p. switchboard on the floor above.

Each incoming or outgoing feeder and main transformer cubicle is fitted with a mechanically remote-controlled type V.T. 3-phase oil circuit breaker, having a maximum breaking capacity of 200,000 kVA and a

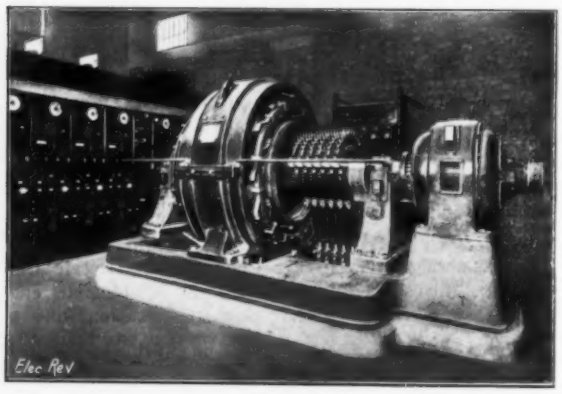

Fig. 14.—B.T.-H. Single-unit Sub-station at Dorking.

separate steel tank for each phase. The cubicles are arranged with the bus-bars in two sections, which can be separated by isolating links when desired, the various feeders and transformer circuits being divided between the two sections.

The d.c. switchgear and a.c. operating panels are on the main floor of the sub-station and arranged as one complete board. The circuit breakers on the d.c. panels are of the new G.E.C. type, whilst the d.c. watt-hour meters were made at the G.E.C. associated Chamberlain and Hookham works.

The complete equipment of the five three-unit sub-stations, one of which is illustrated in figs. 13, 15, and 16, has been provided by the British Thomson-Houston Co., Ltd., and, in addition, the order for feeder-protective apparatus and battery-charging equipment throughout the whole system was entrusted to this company. The three self-synchronising rotary converters in each sub-station have a normal rating of 1,500 kW and run at a speed of 500 r.p.m. They are designed to stands overloads of 25 per cent. for two hours and 150 per cent. for 20 seconds, being guaranteed also to stand a momentary load of four times full load without flashing-over.

Induction-motor starting is used, and the rotaries are synchronised in less than 40 seconds, the starting current being approximately 30 per cent. of the full-load

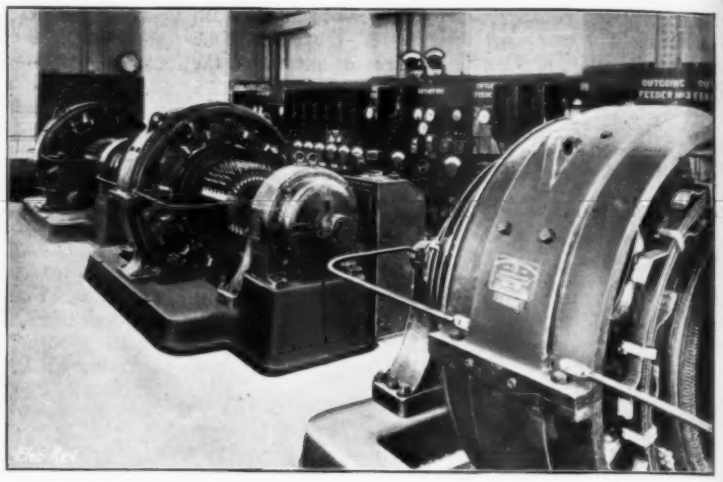

Fig. 15.—A.C. Ends of B.T.-H. Rotaries; Catford Bridge Sub-station.

current. The switchgear is of the cubicle type; except at the Holborn sub-station, the equipment is arranged on two floors, the 11,000-volt switchgear cubicles and outdoor-type oil-immersed transformers being on the ground floor, and the switchgear-operating and metering panels, rotary converters, and starting cubicles on the first floor. The h.p. cables are paper insulated, lead covered, and wire armoured, and each e.h.p. feeder equipment is provided with a set of current transformers for operating the balanced-current protective gear, these transformers being independent of those used for the overload protection and instruments.

The three-phase oil circuit breakers have a breaking capacity rated at 180,000 kVA, and the e.h.p. bus-bars are sectionalised by rotary isolating switches fitted with earth contacts, enabling the whole of one section of the switchgear to be shut down. On the d.c. side the traction feeder panels form an extension of the a.c. switchboard on the first floor, while the positive and negative rotary control panels are placed on either side of the machine transformer feeder panel. The rating of each machine d.c. circuit breaker is 3,000 amperes and of each d.c. feeder circuit breaker 2,000 amperes. The machine circuit breakers are provided with overload

Fig. 16.—B.T.-H. Switchboard; Catford Bridge Sub-station.

trips and auxiliary switches for closing the alarm bell circuit, while a shunt trip is used for cutting the

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machine off the d.c. bars in the event of overspeed or reverse current conditions. Between the lightning arrester and choke coils, which are in the positive track circuit, there is an isolating switch and auxiliary switch, the latter being used to stop the alarm bell ringing after the breaker has opened; if the track should still be alive when the breaker opens, indication is given by a pilot lamp.

Auxiliary supply at the sub-stations is obtained from two oil-immersed, three-phase transformers, ratio 11,000/110 volts, connected to the incoming feeders through current-limiting resistances and controlled from an auxiliary switchboard in a corner of the sub-station; in the event of this supply failing, an automatic change-over switch will connect the lamp circuit to a battery. B.T.-H. "Tungar" rectifiers are used in all the sub-stations on the system to charge the batteries.

Protective apparatus on the system, already mentioned as a product of the British Thomson-Houston Co., is of the multi-parallel feeder type without pilot cables; greater sensibility is obtained on earth faults, as compared with phase faults, although the time setting on each is the same, while under through-fault conditions stability is maintained. Biasing transformers are used and the apparatus can be extended under certain conditions to protect any number of parallel feeders without the necessity for pilot cables. A feature of the system is that there is no necessity for the protective current transformers to be specially balanced, while a load such as that experienced by the Slades Green sub-station, which is teed off from the main line, can be protected merely by the inclusion of incoming protective apparatus in that sub-station.

Nearly 400,000 track bonds were supplied by British Insulated & Helsby Cables, Ltd., for this section of the Southern Railway, the total single-line mileage involved being 250. The rolling stock for the new electrical services consists of 124 three-car train units and 59 two-car units. The three-car units are formed of two motor cars with a trailer car coupled between them. Each motor car is equipped with two 300-h.p. motors made by the English Electric Co. and control apparatus by the Metropolitan-Vickers Electrical Co. The two-car units are not fitted with motors, and will be operated at times of heavy traffic coupled between two three-car units. Inspection of the electrical equipment of the new stock will be carried out at Orpington and Slades Green, and electrical and mechanical repairs will be effected in a new shop at Slades Green which has been built for the purpose. Fig. 14 is a view of the B.T.-H. sub-station at Dorking on the South-Western section of the railway, which will be referred to next week.

(To be concluded.)

Telegraph and Telephone Notes.

Brazil.—TELEPHONE CONCESSION.—The Municipal Council of the State of Sao Paulo has awarded to the Brazilian Telephone Co. (a Canadian corporation), a monopolistic contract for the provision of the whole of the telephone services to the capital. Considerable opposition, emanating from commercial, industrial, and agricultural interests, against the Council's action has been manifested and an appeal to cancel the concession is about to be presented to the State Congress.—*Reuter's Trade Service* (Sao Paulo).

Empire Radio Communication.—INDIA.—It is announced by the *Daily Telegraph* that the Marconi Co.'s engineers have arrived at Bombay from England for the purpose of commencing at once the construction of the "beam" wireless stations at Poona and Dhond in connection with the Empire chain of stations. The chairman of the Indian Radio Telegraph Co., which has undertaken the work, has returned to Bombay after studying systems in America, England, and France.

ENGLISH STATION SITES.—The Postmaster-General announces that a site at Winthorpe, near Skegness, for the receiving station for the "beam" services with Australia and India, was placed by him at the disposal of the contractors on August 8th. A site near Grimsby for the transmitting station was handed to the contractors a few weeks ago; the stations were due, under the contract, to be completed by May 8th, 1926.

Holland.—SHIP-SHORE TELEPHONY.—It is reported that the Dutch Government intends to utilise one or more radio stations as links in a scheme for enabling passengers at sea to talk with people on shore by means of the ordinary telephone facilities. Tests are being carried out and the *Evening News* understands that the ultimate aim is not only to provide a local service, but to extend the facilities to other countries by means of their own land lines. Similar experiments have been made in America, England, and Germany; whereas the Germans used 100-m. waves, the Dutch will probably use a wave-length of between 800 and 900 m.

Italy.—NEW RADIO-TELEGRAPH STATION.—A radio-telegraph station is being built near Rome by Germany as part of her reparation payment to Italy. According to the *Evening News* the station is to cost nearly £780,000, and will be completed next April. It will be able to transmit and receive five messages or programmes simultaneously. The aerials are supported by seven towers, each 850 ft. in length, and covering an area of 150 acres.

International Telephony.—ANOTHER COMMITTEE.—The International Chamber of Commerce complains of the inadequacy of the present Continental telephone services and, according to the *Financial Times*, has appointed a committee, the purpose of which appears to be to develop the use of telephone service internationally and to find practical means of effecting improvements.

The whole system of telephone circuits to France from this country is to be overhauled during the next two months, says the *Morning Post*. Engineers have been sent from the General Post Office to the French coast to inspect the repeaters and cables, while others will overhaul the lines on this side of the Channel. Major J. B. Stevenson has been in charge of all the tests carried out by telephone between London and foreign cities. There are 16 circuits between London and Paris, but it is hoped to create several new "phantom" circuits. The French Post Office authorities, realising the importance of becoming the "switchboard of Europe," hope to finish the overhaul by November in time for the next International Telephone Conference.

Japan.—TELEPHONE DEVELOPMENT.—The Japanese Government has developed a plan for the improvement of the telephone system of the country. According to *Commerce Reports* over 50,000 new telephones will be installed each year during the period 1925-1930, as well as an average of 10,000 miles of new toll lines per year.

Portugal.—NEW RADIO-TELEGRAPH STATION.—On May 20th, 1925, a new radio-telegraph station was opened at Lavadores, a suburb of Oporto, by the Portuguese Government. It will be under the direction of the ministry of marine, and its official name is Posto Radio-telegrafico Naval do Porto at Lavadores, the call letters being CTP. The Marconi systems used are spark and continuous wave on 600 metres and on 2,400 metres respectively, the transmitting range by day is 300 miles, and by night 900 miles. The station has no midday signal, but repeats the meteorological reports from Monsanto (Lisbon) when requested by vessels, free of charge. A radiogoniometer will be installed shortly to give ships their position for a fee.—*Commerce Reports.*

United States.—LONG-DISTANCE TELEPHONY.—The telephone cable, 861 miles long, which links New York and Chicago and has been designed to furnish telephone and telegraph services practically immune from storm interruptions, was joined up at Swanton, Ohio, on August 11th. The cable, which is the longest in the world, the laying of which began seven years ago, is made up of 447,000 miles of wire, and involved an outlay of $25,000,000 (£5,000,000). It will handle 250 telephone and 500 telegraph messages at the same time. Of the total length 717 miles are above ground and 144 miles in underground conduits, says *The Times*.

Radio Notes.

Artists' Dispute.—NEGOTIATIONS SUSPENDED.—The negotiations with regard to artists' services which have been in progress for some time between representatives of British concert promoters and the British Broadcasting Co. have been temporarily suspended, a deadlock having been reached with regard to a continuance of professional services upon the terms hitherto in force.—*Daily Mail.*

B.B.C. Studios.—LONDON IMPROVEMENTS.—A large new studio is being equipped at 2LO, the London station. The ceiling and walls are being hung with adjustable curtains, arranged on a system of wires, swivels, and pulleys, so that the producer of a play or dramatic entertainment will be able to control the volume of sound. Hitherto only the engineers have been able to vary the volume. Folding glass doors across the middle of the studio will enable one half to be used for "effects" and "noises," and the other for the artists; the floor is of stone. The present upper studio, from which entertainments have been broadcast for the last three years, is to be abolished, but the main studio is being retained, while a new studio for talks only is being furnished.—*Daily Mail.*

Broadcast Advertising.—A SHEFFIELD SUGGESTION.—The Sheffield representative of the British Broadcasting Co. has, we understand, invited the Chamber of Commerce of the city to introduce to his company representative speakers—business men interested in the city's affairs—who could advertise the city and its productions by means of broadcasting.

Canada.—NEW STATION.—The new Vancouver broadcasting station of the Canadian National Railways was opened on August 12th at 5 a.m. British summer time, bringing the number of the C.N.R. stations up to ten. The call of the new station is CNRV and the wave-length 291 metres. The studio is in Vancouver, but transmission will take place from Lulu Island, a short distance away.

France.—WAVE-LENGTH TESTS.—As the result of the recent meeting at Geneva of the directors of the International Radiophone Union, wave-length tests were conducted from the Eiffel Tower, Paris, at night last week-end. The wave-lengths used were 64 and 200 metres. Similar experiments will take place next week.

New Continental Stations.—BRITISH PLANT.—A further field for long-distance listeners will soon be available when the new broadcasting stations at Milan (Italy) and Brno (Czecho-Slovakia) are opened. They are being erected by Marconi's Wireless Telegraph Co., Ltd., and are of the same type and power as the new 2LO station; the power used will be 12 kW. The Peruvian broadcasting station at Lima (call letters OAX and wave-length 360 metres) which was formally opened on June 20th, is giving very satisfactory results. This station uses a standard Marconi 5-kW type "Q" transmitter.

Receiving Licences.—PROCEEDINGS THREAT.—The Postmaster-General calls attention to the fact that now that the Wireless Telegraphy (Explanation) Act has been passed, the legal obligation to take out a licence for a receiving set—whether crystal or valve—has been placed beyond doubt, and he gives notice that he proposes in future to institute proceedings in cases coming to his knowledge in which sets are installed or used without licences.

SUMMONSES ISSUED.—Mr. R. M. Ford, who some time ago challenged the Postmaster-General to prosecute him for not having purchased a licence, has sent a communication to the Postmaster-General, in which he says that under Section 1, sub-section 7, of the Wireless Telegraphy Act, 1904, he proposes using electrical apparatus for purposes other than the transmission and reception of messages (with which alone the Wireless Acts are concerned), and calls upon the Postmaster-General to take such steps as may be necessary to prevent Post Office messages reaching his apparatus. Mr. Ford has, it is understood, received three summonses issued at the instance of the Postmaster-General.

Short-wave Transmission.—NEW STATION.—It is announced that the Edison Swan Electric Co., Ltd., has had the call sign 5VR allotted to it, and will shortly commence experimental transmission on wave-lengths of 23, 45, and 90 metres. Reports of reception will be appreciated and acknowledged by the company, and times of special tests will be sent to anyone on request.

The Radio Industry.—In a report issued for the benefit of the American wireless manufacturing industry by the American Government trade experts, it is declared that the development of the wireless industry in Great Britain has reached such a high state of efficiency that American wireless apparatus manufacturers cannot hope to compete in the British market.

Contracts Open and Closed.

(The date given in parentheses at the end of the paragraph indicates the issue of the "Electrical Review" in which the "Official Notice" appeared in our advertisement pages.)

Open.

Adwick-le-Street.—Urban District Council. September 11th. Internal wiring for electric lighting of Council houses. (See this issue.)

Australia. — MELBOURNE. — September 29th. Postmaster-General's Department. Telephone protective apparatus.*

October 20th. Switchboard cable. Sched. C.39, jumper wire. Sched. C.40, bells and buzzers.*

NEW SOUTH WALES.—November 11th. New South Wales Railways and Tramways. 5-ton 3-motor electric overhead travelling crane, 56 ft. 2 in., for iron and steel foundry, Eveleigh workshops.—*Tenders.*

September 23rd. Four feed-water meters for White Bay power house.

October 15th.—Newcastle City Council. 2,000-kW. or, alternatively, 1,500-kW turbo-alternator, complete with condensing plant.—*Tenders.*

October 7th. Victorian Government Railways. Two electric transporters complete. (AX.2303.)*

Commonwealth. October 27th. Timing clocks and calculagraphs. (See this issue.)

Bristol.—August 27th. Board of Guardians. Electrical fittings for six months for St. Peter's Hospital. (Particulars from T. S. Lamb, clerk, at the hospital.)

Egypt.—CAIRO.—September 9th. Ministry of Education. One 50-h.p. Diesel engine, generator, electric motors and machine tools for the Mansurah Trades School.*

Ministry of the Interior. Supply and installation of an electric power station and distributing system for the town of Minieh.*

Edinburgh.—September 14th. Royal Infirmary. Supply of X-ray and electro-medical equipment for the new Radiological Department. (August 14th.)

Fleetwood.—August 24th. Urban District Council. Feeder cable and pillar. (August 7th.)

India. — September 15th. Madras and Southern Mahratta Railway Co., Ltd. Telegraph line materials, copper wire, &c. (See this issue.)

Leeds.—August 25th. Property Committee. Electric lighting work required for public wash-houses and slipper baths at Stocks Hill.

London.—ACTON.—August 28th. Borough Council. Overhead wiring at the Council's Isolation Hospital, Wales Farm Road, Acton. (August 7th.)

Newport (Mon.).—September 7th. Electricity Department. Induced draught plant, extension of flues, &c. (See this issue.)

New Zealand.—WELLINGTON.—September 29th. Public Works Department. 560 galvanised steel transmission line towers, complete with cross-arms, ground stubs, and accessories. (A.X. 2,250.)*

MARLBOROUGH.—Electric Power Board. September 22nd. Two 750-h.p. turbines, with generators, switchboard, &c., for Waihopai River development.—*Tenders.*

Portsmouth.—September 1st. Tramways Committee. Stores for 12 months, including insulating materials, lamps, overhead line materials, &c. (See this issue.)

Rochdale.—September 9th. Paving and Sewering Committee. Motors and electrical gear, together with the necessary wiring in connection with the electrification of sludge pressing machinery at Roch Mills sewage disposal works. (August 14th.)

South Africa.—JOHANNESBURG.—October 1st. Railways and Harbours. Four 4-ton electrically-driven portable jib cranes, complete. (A.X.2299.)*

Stockport.—September 5th. Board of Guardians. Conversion of lift at Stepping Hill Hospital from hydraulic to electric power. Particulars from the Steward at the hospital.

Stoke-on-Trent.—Stoke and Wolstanton Union. Installation of an electrically-driven pumping plant at the Turnhurst Road Institution, Chell. Specification from Mr. T. Wood, Clerk to the Guardians, Stoke-on-Trent.

Town Council. E.h.p. testing equipment. (See this issue.)

Warrington.—September 7th. Electricity Department. Twelve months' supply of earthenware conduits. (See this issue.)

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Closed.

Edinburgh.—Electricity Committee. Recommended:—

Soot blowers (£1,168).—Stirling Boiler Co., Ltd.
Switchgear for sub-station at Saughton (£775).—A. Reyrolle & Co., Ltd.
Transformers for Saughton sub-station (£540).—Ferranti, Ltd.

Glasgow.—Cleansing Committee. Recommended:—

Frequency changers for new refuse works (£8,197 each).—Messrs. Bruce Peebles & Co., Ltd.
Refuse power plant: Turbine, Fraser & Chalmers Engineering Works; alternator, General Electric Co., Ltd.; condensing plant, Messrs. Mirrlees, Watson & Co.; transforming plant, Messrs. Ferranti, Ltd.; cooling towers, Premier Cooling & Engineering Co.

Tramways Committee. Accepted:—

Crossings and crossovers.—Messrs. Edgar Allen & Co., Ltd.

Recommended:—

D.c.c. wire.—London Electric Wire Co. & Smith's, Ltd.
L.c. cable.—Western Electric Co., Ltd., and the Hackbridge Cable Co., Ltd.
Two steel wire haulage ropes for the Subway (£6,544 each).—Messrs. T. & W. Smith, Ltd., and Messrs. R. S. Newall & Sons, Ltd., Liverpool.

In this connection the Committee reports that five tenders were received all at the same time, and it has recommended that with regard to future supplies foreign tenders be invited. The Committee has asked the Town Clerk to call the attention of the Government to the position of matters in the supply of wire rope as disclosed by the fact that the prices quoted for the contract are the same in all cases.

Haworth.—Urban District Council. Accepted:—

Erection of sub-station in connection with a supply of electricity from Keighley.—Mr. E. Metcalfe.

Irish Free State.—DUBLIN.—Borough Commissioners. Materials for the wiring of 180 houses on the Marino Estate:—

Wire (approximately 25,000 yd. required) per 100 yd.—

	£	s.	d.
Kabelwerke Duisberg	0	8	5
Holland Insulated Wire & Cable Works	0	9	6
Deutsche Kabelwerke. (Accepted.)	0	9	6½
Siemens-Schuckert (Ireland), Ltd.	0	10	9
Land-und-Seekabelwerke	0	12	5
Macintosh Cable Co., Ltd.	1	1	6
Drake & Gorham Wholesale, Ltd.	1	1	6
W. T. Henley's Telegraph Works Co., Ltd.	1	1	6
General Electric Co., Ltd.	1	1	6
British Insulated & Helsby Cables, Ltd.	1	1	6

Capping and casing (approximately 30,000 ft. required) per 100 ft.—

General Electric Co., Ltd. (Accepted.)	0	7	7½
British Insulated & Helsby Cables, Ltd.	0	11	6

Leeds.—Tramways Committee. Accepted:—
50 gear wheels.—National Steel Foundry (1914), Ltd. (£443 15s.).
Special work for siding.—Titan Track Work Co., Ltd. (£300).
Special track work.—Edgar Allen & Co., Ltd. (£790 and £805); Messrs. Hadfields, Ltd. (£1,800); Titan Track Work Co., Ltd. (£870 and £700).

London.—London and North-Eastern Railway Co. Accepted:—
Four e.l. type welding plants for Stratford Works.—Equipment and Engineering Co.

Manchester.—Electricity Committee. Accepted:—
Adhesive tape.—L. Andrew & Co., Connolly's (Blackley), Ltd.
Batteries (dry).—Ever Ready Co. (Great Britain), Ltd.
Box compound.—British Insulated & Helsby Cables, Ltd.
Bittite tape.—Callender's Cable & Construction Co., Ltd.
Cable cover tiles.—Doulton & Co., Ltd., Hall & Rogers, G. Woolliscroft and Sons, Ltd.

Margate.—The Education Committee. Electric lighting installation at the Girls' Central School and Gymnasium:—
A. F. Dunkley (accepted), **£235.**
E. A. Pinto, £223.
W. J. Cannon & Co., £223.
C. Hayward & Son, £237.
E. Saunders, Ltd., £256.
H. S. Tett & Co., Ltd., £260.
Baker & Sons, £319.

Sheffield.—Electricity Committee. Accepted:—
Three 500-kVA transformers (£1,169) and one 500-kVA transformer, Scott-connected (£502).—British Electric Transformer Co., Ltd.
Twelve 8-way, 3-phase, 4-wire feeder pillars (£633).—Messrs. W. Lucy and Co., Ltd.
Erection of sub-station in Benly Lane (£1,093).—Messrs. Wellerman Bros., Ltd.

Stretford.—Electricity Committee. Accepted:—
Increasing the capacity of the ash bunker (£394).—H. Simon, Ltd.

Winchester.—City Council. Accepted:—
Extensions to the electricity works (£3,489).—Wise & Lansdell, Ltd.

Forthcoming Event.

British Association for the Advancement of Science.—At Southampton. From August 26th to September 2nd. Ninety-fifth annual meeting.

Notes.

A District Apprentice Training Scheme.—We learn from *Machinery* of an interesting scheme in connection with apprenticeship training which is being developed in Milwaukee, U.S.A., where a "district apprentice system" has been inaugurated. A group of shops in a given locality, or in a certain district of a large city, co-operate in the training of apprentices, who are transferred from shop to shop to obtain diversified training. The speciality shop may take them for only a few weeks, teaching those processes that are highly developed in its plant. The small shop takes them in hand for training in the processes likely to be more highly developed in a small organisation than in a large one. In this way all the shops in a certain locality aid in developing an all-round mechanic, each one bearing its share of the burden of providing for the supply of future skilled machinists, and none can offer the excuse that the special conditions under which it operates make it impossible to carry its share of this obligation. The apprentice also profits by obtaining a more all-round training than he would be likely to get in a single shop.

The Professional Classes Aid Council.—ANNUAL REPORT.—The report of the Council for the past year shows that applications for help received during the year numbered 686, and financial assistance was given to 150 families, affecting 344 individuals; 305 other applicants were advised where to obtain help. Special attention was given to education and training, as the most satisfactory branches of expenditure; 62 boys and girls were helped with school fees, outfit, and in some cases maintenance, and 41 persons were in training. In many cases help given in emergency for a short period enabled a person to regain employment, and the Council was successful in obtaining pensions from other sources in several cases. The expenditure increased from £6,645 to £8,388, resulting in a deficit of £880. The Council would welcome contributions sent to the Secretary, 251, Brompton Road, London, S.W.3.

Marine Direction-finder Improvement.—An improvement in ships' direction-finding equipment has been made by the Marconi International Marine Communication Co., Ltd. It consists of the replacement of the large double-loop aerial system by two fixed-frame aerials, which are mounted in a rigid wooden framework, measuring 8 ft. in height by 4 ft. square. The two frames are fixed permanently at right angles to each other, one being parallel to the fore and aft line of the ship, and the other athwart-ships. The aerials are formed by a number of turns of stranded wire, the ends of the loops being taken through insulated connections to the direction-finding instrument. This development obviates the use of expensive fittings in the way of posts or stays to support the aerials and allows great latitude in the position of the direction-finding instrument itself, for it is not necessary to install the instrument immediately under, or even adjacent to the aerial system. The two recent additions to the Cunard fleet, the *Alaunia* and *Carinthia*, have both been equipped with this new direction-finding installation, bringing the number of Cunard ships carrying Marconi direction-finding apparatus up to 15, while 10 other ships have been or are being equipped.

A Russian Diesel-Electric Locomotive.—According to our Russian contemporary *Elektritschestwo* a new Diesel-electric locomotive has recently been put into operation on the "Oktober," formerly known as the Nicolai, railway. It has been built to the designs of Prof. Haekel, of Leningrad, and except for the engine and roller bearings is entirely of Russian construction. The motive power is supplied by a Vickers ten-cylinder engine of the four-stroke, non-reversible type, and is stated to develop 1,030 h.p. at 935 r.p.m. It is located in the centre of the locomotive and drives a generator at each end. Normally the two generators are designed to give 1,500 amp. at 380 V, but at low speeds, that is, under 19 m.p.h., they are run in parallel to give 3,000 amp. The locomotive has altogether 24 wheels—a leading and trailing pair and ten axles, arranged in groups of three, four, and three, each driven by an electric motor, the ten motors working in parallel. The engine is started by one of the generators, which can be made to run as a motor when it is supplied with current from a 600-Ah, 110-volt battery of accumulators. The locomotive can be driven from either end, the controller being adapted to give 13 parallel and 7 series working positions. The total weight of the machine is 180 tons.

New Aluminium Alloys.—The *Zeitschrift fur Metallkunde* states that the Frankfort Metal Bank, of Frankfort-am-Main, has lately introduced two new aluminium alloys known as "Seleron" and "Aeron," which are claimed to be specially useful for the manufacture of electrical apparatus. The alloys consist of 85 per cent. aluminium, the balance being made up of Cu, Ni, Zn, Mn, Si and lithium; it is the latter element which is stated to give the alloys their great elasticity and hardness. The melting point is stated to be 600 deg. C., the specific gravity between 2.8 and 3, and the limit of elasticity 10 to 20.

C.T.A.A. Dinner.—It will interest many of our readers to know that the Chief Technical Assistants' Association has arranged for a dinner in honour of two members who have recently been appointed borough electrical engineers—Messrs. John H. Parker and William Weekes. The dinner will be held in the St. Dunstan's Room, Anderton's Hotel, Fleet Street, on Saturday, August 29th, at 6.30 p.m.

A 5-ton Electric Tractor.—The latest production of Messrs. Richard Garrett & Son, Ltd., Leiston, is an electric tractor capable of hauling a trailer with a load of 5 tons. Weighing approximately 2 tons, the tractor has a normal drawbar pull of 500 lb. and a temporary maximum of 3,000 lb.; hauling a full load the vehicle can on hard level roads cover a distance of 32 miles on a single charge of the battery.

Trade Facilities Guarantees.—An official paper issued last week states that the guarantees which have been given by the Treasury under the Trade Facilities Acts, 1921-1924, up to June 30th, 1925, amount to £54,452,936. Recent guarantees include £20,000 (guaranteed as to principal and interest) to the St. Austell and District Electric Lighting and Power Co., Ltd., for the erection and equipment of power station and provision of mains; £1,250,000 to the Benguella Railway Co. (guaranteed as to principal and interest for 25 years) for the purchase of rolling stock and railway materials in Great Britain; and £50,000 to the Nottingham Coal Carbonization, Ltd. (guaranteed as to principal and interest for seven years) for the erection of plant to treat coal by a process of low-temperature carbonisation.

The Hydro-Electric Power of Tasmania.—We have received from the chief engineer and manager of the Hydro-Electric Department of Tasmania a publication under the above title. It comprises a well-illustrated and thorough description of the Great Lake hydro-electric development, and of the Tasmanian electricity supply system. Apart from the description of the works, including the constructional operations, considerable space is given to the history of the concern and to the transmission system, &c. The establishment of the plant was due to the foresight of Mr. J. H. Gillies, a Melbourne metallurgist, who in 1908 realised the developments possible by the utilisation of the great water reservoir. He formed a company to undertake the project, but owing to financial difficulties the work was taken over by the Tasmanian Government. The initial installation of 10,000 h.p. was put into operation in 1916, and the station was completed to its present capacity of 52,000 continuous h.p. in 1923. The electrolytic industries which Mr. Gillies aimed to establish, *viz.*, the production of zinc and carbide, are now established, and electrical energy is being distributed over a large area. The rates charged to the electrolytic industries are extremely low; the Electrolytic Zinc Co. has a contract of 30,000 h.p. at £2 per h.p. per annum. The work is published by the Tait Publishing Co. Pty., Ltd., Melbourne, &c., at the very reasonable price of 2s. 6d. There are 60 illustrations, many of which are detailed drawings of the plant.

Parliamentary Loud-speakers.—When the Italian Parliament reopens the Chamber and Senate will be joined by a direct telephone wire, which, by means of microphones and loud-speakers, will permit speeches made in one House to be heard in the other. The microphones will be placed on the orators' tribunes, and the loud-speakers will be at the back of the President's bench. When the two Houses sit simultaneously the device will be switched off to avoid interference

The Italian Electrical Industry.—The development of the electrical industry in Italy has so far proceeded that at the beginning of this year the total plant installed represented 2,107,000 kW, of which 545,000 kW applied to Piemont, 500,000 kW to Lombardy, 205,000 kW to Venice, and 170,000 kW to Umbria. In 1923-24 the total consumption of energy amounted to 6,200 million kWh and it is expected to exceed 7,000 million kWh this year. As to the distribution in the former year, it is reported that the mechanical industries absorbed 51.4 per cent., the textile industry 13 per cent., electro-chemistry and electrometallurgy 11.3 per cent., lighting 9 per cent., the food industries 8 per cent., and traction 7.3 per cent. The aggregate capital invested in the electricity supply industry, comprising about 170 companies, amounts to 5,000,000,000 lire, of which 4,300 million lire is held by the large groups of the S.I.P. of Turin, the Edison group of Milan, and the Adriatica group of Venice.

Versatile Electrical Contractors.—A recent note in the official organ of the E.C.A. appears to confirm a view which is held by a number of people that the day is approaching when every man will be his own electrical contractor. The note quotes two instances of the combination of contracting with other businesses very remote from it. The first presents a chimney sweep who announces on his trade card: "Chimneys swept; electrical installations." The other records a visit of a member of the E.C.A. to the Isle of Wight, where he inspected a dairy in a window of which radio apparatus was displayed for sale. The proprietor described himself as a "Cowkeeper, builder, and decorator."

The "Blackstone" Spring Injection Oil Engine.—We have been informed by Messrs. Blackstone & Co., Ltd., that the "Blackstone" spring injection heavy-fuel-oil engine, which we described in our issue of August 14th, was awarded a silver medal at each of the following agricultural shows held this season: the Royal Dublin Society's Agricultural Show in May, the Royal Lancashire and the Northumberland Agricultural Shows in July, and the Royal National Welsh Show in August. It is claimed that with oils at their present prices, the "Blackstone" engine will develop power at the rate of 50 b.h.p.-hours for 1s.

A Novel Hydro-electric Plant.—A novel type of hydro-electric plant has been set to work by an American firm in Yungan, Fukien, China. It comprises a 36-in. turbine working under a head of 10 ft. and driving a vertical shaft reaching above the dam. Bevel gearing and a belt are used to drive the 25-kVA generator, which is arranged on a lighter moored on the upstream side of the dam. This arrangement was adopted so that the electrical plant would be safe in case of flood. The set lights the native city.—*Indian Engineering.*

Fatalities.—An inquest was held at Greenwich on August 12th into the death of Charles Harwood, assistant switchboard attendant at the Stowage Wharf generating station of the London Electric Supply Corporation. From the evidence it appeared that the deceased was told to attend to an earthing device in a 10,000-V switch room. As he was absent a long time fellow workers went to the room and found Harwood lying on the floor with burns on the fingers of one hand. The inquest was adjourned.

At the City of London Coroner's Court on August 12th, Mr. F. D. Thomas held an inquest into the death of George W. Stimson, who was killed while engaged in the construction of the new Post Office tube which will connect the head office with the principal London railway termini. Major J. R. Kingston said that the deceased man, who was travelling with six others in a trolley, must have raised his head and have been caught by the top of the tunnel. Although the work had been in progress for three years, with men constantly travelling in this manner, this was the first fatality. A verdict of "Accidental death" was recorded.

Smoke Abatement Conference.—The ever-increasing interest in the problem of securing a purer atmosphere, with its resulting benefits, will receive a further impetus from the Smoke Abatement Conference to be held at the Palace Hotel, Buxton, in the autumn. This meeting, which is to take place during the week-end, October 2nd to 5th, is being arranged by the Smoke Abatement League of Great Britain, 33, Blackfriars Street, Manchester, and support is promised from many influential quarters. Certain practical proposals for reducing both domestic and industrial smoke are being prepared by the League for full consideration by those attending, and prominent individuals have agreed to open the discussions at the various sessions. It is hoped that a constructive programme of useful work will be initiated, the results of which can be reviewed at the Smoke Abatement Exhibition and Conference to be held at Firmingham in 1926.

Appointments Vacant.—Junior cable engineers to fill positions of mains clerks of works for Hackney Borough Council Electricity Department; second assistant engineer in the Electricity Department of Worthing Corporation; combustion engineer or efficiency man at the Figeon House electricity works for the Dublin Corporation; plumber-jointer for the Radcliffe Urban District Council, electricity department; draughtsman, £160 + bonus, for the Royal Air raft Establishment, South Farnborough. (See our advertisement pages to-day.)

Educational.—The 1925-26 session of the Engineering Day College of the Northampton Polytechnic Institute, St. John Street, E.C.1, commences on September 28th. (See our advertisement pages to-day.)

Electrical Development in Alsace-Lorraine.—The *Electrical World* says that the electrical industry of Alsace-Lorraine pays a much higher wage scale than prevails throughout the rest of France. This is considered a handicap, and legislation or regulation to remove it is sought by the producers and distributors of electricity. The electrical companies of Alsace, basing their average wage scale on the rate in vogue at Strasburg in 1914, have paid an average wage since 1918 which shows an increase of 270 per cent., whereas the increase in the rest of France is but 155 per cent. In 1924 346 million kWh was distributed in this province, against 291 millions in the proceding year. The Franco-Swiss agreement with respect to the regulation of the flow of the Rhine river by a dam at Kembs will largely increase the possibilities of producing electrical energy throughout the region, which, it is asserted, will accordingly become that part of France where the use of electrical energy will see its highest development.

Electricity in Large Brick Field.—According to the *Electrical World*, the Brisch Brick Co., Stickney, Ill., is building a plant with a capacity for eight million bricks per month, in which 1,000 h.p. of electric motors will be installed. Among the motor-driven machines will be an electric drag for handling clay from the pits. The consumption is estimated at 13 kWh per thousand bricks. The supply will be taken from the Public Service Co. of Northern Illinois by means of a 33,000-V line.

Ship Electric Lighting.—The s.s. *Hildebrand*, one of the Booth Line, is fitted throughout with "Osram" electric lamps. The saloon is illuminated by 100-V, 40-W "White Osrams," and ventilated by "Freezor" fans.

Thin Leaf Metals.—According to the *Financial Times*, Professor Mueller, of the Reich Physical and Technical Institute in Berlin, has succeeded in producing leaf metals of hitherto unattained thinness. He has obtained gold leaf, silver leaf, steel leaf and copper leaf a millionth of a centimetre thick and completely transparent. The invention is regarded as being of great importance for technical work.

New Guatemalan Railway.—Some further particulars are now available regarding the electric mountain railway which is to be built between San Felipe and Quezaltenango on the Pacific Ocean side of Guatemala, the contract for which has been secured by the A.E.G., of Berlin, Germany. The necessary power is to be supplied by a hydro-electric station with an original capacity of 5,600 h.p., but capable of being later extended to 14,000 h.p. The line will have a length of about 28½ miles, in the course of which it will rise from an altitude of 1,640 to about 9,840 ft. above sea level. It is mainly intended for the transport of the coffee grown on the high lands in the Quezaltenango district.

A New Type of Hack-saw Blade. — Messrs. Fry's (London), Ltd., inform us that, as the result of a new machine which they have recently perfected, they are putting on the market a new type of hack-saw blade, the "Exray Flex." It is claimed that this blade is without any hard-defined portion liable to break off, and owing to a more uniform hardening process, has stood tests more severe than the usual blade is called upon to stand. It is further claimed that the blade can be bent in a coil of about 1 in. diameter and then uncoiled without any fracture in any portion of it; also that it does not require the experience of a trained mechanic in use.

Coal v. Electricity on the Swiss Railways.—Under the above title the United States Commercial Attaché at Paris recently reported that the high cost of water-power development in Switzerland had rendered it questionable whether hydro-electric power was really cheaper than coal for running the Swiss Federal Railways. "The use of water power is unquestionably desirable in theory, since such a development would remove from the trade balance a large part of one of the most important of the import items—coal—and thus contribute to the economic and political independence of Switzerland. Looked at from a commercial point of view, however, electrification may be bad business if, for a long period, operation costs are greater than would be involved in continued use of steam locomotives." It was shown that coal prices had fallen since electrification had been decided upon and were still decreasing. "Under these circumstances, with already heavy fixed charges, decreasing traffic, and high freight and passenger rates, it is obvious that the demand for a revision of the electrification programme, or at least a slowing down of its execution until the economic outlook becomes clearer, will receive increasing popular support."

Progress of French Railway Electrification Schemes.—The *Electric Railway Journal* says that the electrification of the Paris-Orleans-Bordeaux lines is nearing completion. The lines are largely of suburban or interurban classification, the long stretches over which it was proposed to run the Franco-Spanish international expresses being relegated to a more remote future. The company has erected a locomotive shop at Vitry-sur-Seine in suburban Paris for the equipment and repair of its electric locomotives already in service on the Austerlitz-Juvisy and Bretigny-Dourdan lines, and a new section, Bretigny-Juvisy, is soon to have its energy from a new sub-station. During the past year the company has received ten electric locomotives, three electric motor-cars, 34 passenger cars and nine freight cars, for its electric lines. Delivery is expected soon of 195 electric locomotives, 77 electric motor-cars and 76 trailers.

A Ceylon Hydro-Electric Scheme.—Our Indian correspondent says that an important hydro-electric scheme is being carried out in Ceylon. The necessary water is to be obtained from the Aberdeen and the Laxapana rivers, both of which rise in the central plateau of the Island, at an elevation of some 6,000 ft. They fall rapidly in gradually converging valleys, until they meet and form the upper reaches of the Kelaniganga at an elevation of about 400 ft. Advantage is to be taken of the rapid fall and proximity of these two streams to convey the water by conduits to a point on the ridge dividing the two valleys, where the combined flow can be concentrated and led down the hillside in pipes to the power-house. In the first instance a gravity section masonry dam is being built on the Kehelgamu-oya; this will impound sufficient water to deal with a daily peak load of over 40,000 kW at minimum flow. The intake to the outlet conduit is to be placed 150 yd. above the dam. The conduit will be able to carry enough water to provide for a peak load of 50,000 kW. The forebay is to consist of a tunnel driven through Morahenaganga Hill, terminating at the outlet end in a built penstock chamber or surge tank, the outer walls of which will carry the penstock sluices. This chamber will be divided into two by a wall, and each half of the chamber will have its own inlet and scour valves, so that either may be closed for cleaning, or when otherwise necessary, without interfering with the other. Steel pipes 40 inches in internal diameter will connect the surge tank with the power-house. At first only two lines of pipes are to be laid, but for the full scheme there are to be six. The length of the pipes, from the forebay to the power-house, will be 5,250 ft. and the vertical fall 2,050 ft. The spot chosen for the power-house is 20 feet above the highest recorded point reached by the river when in flood. Rock foundations are situated at a depth of 10 ft. below the surface of the ground. The initial capacity of the station will be 12,000 kW as a 24-hour load. Work for the second stage will include the construction of a reservoir at Glencairn; the extension of the penstock chamber; the laying of an additional line of 40-in. pipes; and the extension of the power-house, generating plant, &c. At the completion of the second stage the power-house will be able to supply 34,000 kW as a 24-hour load, the total capacity of the plant installed being 52,000 kW. In stage 3 the flow from the Laxapana or Maskeliya-oya Valley will be taken in, the result being that the capacity of the power-house will be more than doubled, the total capacity of the plant installed being 104,500 kW, and the total 24-hour output raised to 71,300 kW. It is expected that the first stage will be completed in from three to four years. The other two stages will be proceeded with as and when the demand for power warrants their being undertaken.

South Canadian Electrical Development.—We learn from the *Electrical World* that the Southern Canada Power Commission has completed the installation of six 5,000-h.p. units at Hemming's Falls, near Drummondville, Quebec. Several new transmission lines are also nearly completed. These will supply energy to all the more important districts on the south side of the St. Lawrence by two separate lines, thereby minimising the possibility of interruption, and improving the service. The company has recently completed a sub-station at Richelieu connecting with the system of the Montreal Light, Heat & Power Co.

Our Personal Column.

(Electrical men are invited to enable us to keep readers of the "Electrical Review" posted concerning their movements.)

The York Corporation Electricity Committee recommends that Mr. ERNEST M. PEARSON, of Lancaster, be appointed chief assistant technical engineer, at a salary of £450 per annum.

Colchester City Council has appointed Mr. W. H. SOULBY as tramway manager, in succession to Mr. R. C. Bullough, at a salary of £350 per annum.

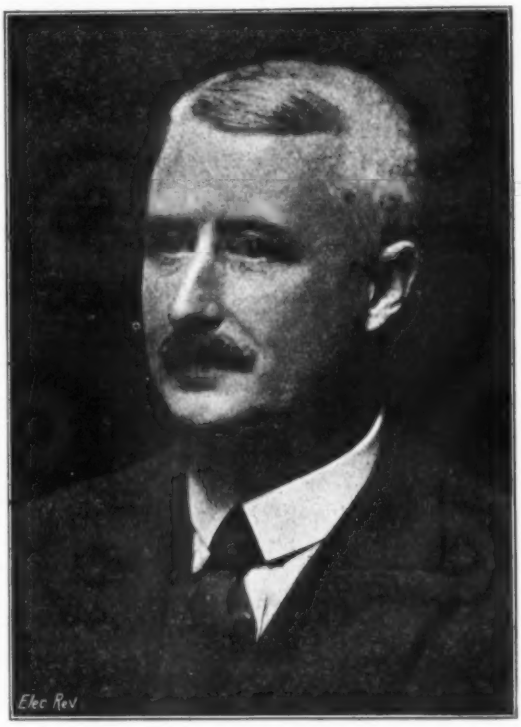
Mr. E. R. BRIGGS, who has been with the English Electric Co., Ltd., for many years and has been chief mechanical engineer, has been appointed to succeed Mr. H. F. Hemmings as works manager at the Willans Works, Rugby.

SIR HENRY MAYBURY, Director-General of Roads, and chairman of the London Traffic Advisory Committee, left this country on Saturday last on a visit to study traffic conditions and the methods of dealing with them in the principal cities of the United States.

MR. L. M. JOCKEL, A.M.I.E.E., chief assistant engineer at Willesden electricity works, is leaving the North Metropolitan Electric Power Supply Co. at the end of the current month to take up the position of station superintendent at the Nottingham Corporation's new "super station" at North Wilford. Last year Mr. Jockel was elected vice-chairman of the Junior Institution of Engineers, of which he is one of the most active members.

MR. W. WILDE, charge engineer at the Horden "B" power station of the Newcastle-on-Tyne Electric Supply Co., Ltd., has been appointed charge engineer at the Lancaster Corporation electricity works.

The accompanying portrait is that of Mr. V. WATLINGTON, who is acting as managing director of the English Electric Co., Ltd., during the absence on leave of Mr. P. J. Pybus. Mr. Watlington was educated at Bedford Grammar School and, later, at the City and Guilds Engineering College under Prof. W. E. Ayrton. He obtained the A.C.G.I. diploma in 1896. Upon leaving college he joined Messrs. Robert Blackwell and Co. and was engaged on the construction and equipment of tramways in all parts of the United Kingdom. In 1906 he founded the firm of Watlington & Co., which specialised in the supply of tramway materials. This firm was subsequently absorbed by the Siemens & English Electric Lamp Co., Ltd.,



Gainsborough Studio.] [*London.*

Mr. V. Watlington, M.B.E., A.C.G.I., M.I.E.E.,
Acting Managing Director of the English Electric Co., Ltd.

of which Mr. Watlington is a director. He joined Messrs. Dick Kerr & Co., Ltd., as sales manager in 1911, and when the English Electric Co., Ltd., was formed in 1919 he was appointed general sales manager. Mr. Watlington has been chairman, since its inception, of the Revising Committee of the E.E.A., which has standardised general contract conditions for the electrical industry. He is a Member of the Order of the British Empire and of the Institution of Electrical Engineers.

The Leeds Corporation Electricity Committee has made the following staff promotions: Mr. H. TOPHAM, from shift engineer to assistant mains engineer (Grade 8a); Mr. T. HEWSON, from assistant shift engineer to shift engineer (Grade 8a); and Mr. R. ROGERS from assistant switchboard attendant to assistant shift engineer.

MR. J. G. M. HILTON, who is well known in Indian electrical engineering circles, has been appointed sales engineer in the Far East for Messrs. Johnson & Phillips, Ltd. His headquarters will be in Singapore, and his address for the present is c/o the company's commercial agents, Messrs. Sime, Darby and Co., Ltd., Singapore.

Obituary.—MR. E. P. SIMPSON.—The death occurred at a nursing home on August 12th of Mr. Edward Percy Simpson, a director of Worthington-Simpson, Ltd.

MR. A. A. KENT.—The death is reported of Mr. A. A. Kent, who was for many years inspector of telephones in the Uxbridge district.

MR. A. E. MILLS.—*The Times* reported the death, on August 15th, of Mr. Alfred Ernest Mills, M.A., M.I.E.E., at North Finchley. Mr. Mills was a Fellow of the Physical Society and a consulting engineer.

SIR ADAM BECK.—The death occurred at London, Ontario, on August 18th, of Sir Adam Beck, LL.D., who had been suffering from pernicious anæmia for some time. Sir Adam was a powerful figure in Canadian politics, particularly in the province of Ontario, but it was as chairman of the Hydro-Electric Power Commission that he was known to our readers. Although a Conservative in politics, he was a vigorous proponent of the public ownership of the abundant water power with which Ontario is blessed, including the Canadian side of the Niagara Falls. From his *début* as a cabinet minister in the Ontario Government, in 1905, right up to his death he directed in the ablest manner the hydro-electric affairs of the province, and the huge undertaking, whose latest

report is by a coincidence reviewed in this issue, is a lasting monument to his courage and ability. Sir Adam, although of German descent, was a native of Ontario and thoroughly Canadian in his outlook. He was knighted in 1914 in recognition of his services in connection with the treatment of tuber-

The Late Sir Adam Beck, LL.D.,
Chairman of the Hydro-Electric Power Commission of Ontario.

culosis. He was a horse breeder of note, and during the war acted as Director of Remounts to the Canadian forces.

Sir Adam contributed a special article on Canadian water power to the Jubilee Issue of the ELECTRICAL REVIEW in November, 1922.

MR. W. M. MILNES.—We regret to hear that Mr. W. Mayall Milnes, A.M.I.E.E., M.Inst.T., general manager and engineer of the Wigan Corporation Tramways, passed away recently while on holiday. Mr. Milnes was formerly assistant engineer and manager of the Coventry tramways.

Will.—The late Mr. R. H. BEST (chairman of Messrs. Best and Lloyd, Ltd., Birmingham) left £85,280 gross and £82,746 net personalty.

New Companies Registered.

Thames Welding Co., Ltd. (207,800).—Private company. Registered August 10th. Capital £5,000, in £1 shares. Objects:—To carry on the business of electric arc and oxy-acetylene cutters and welders of metal and alloys, smiths, founders, workers, manufacturers of and dealers in all kinds of metals or electrical appliances, &c. The subscribers (each with one share) are:—A. J. Markwell, 38, Bellingham Road, Chesham, Bucks., clerk; and F. H. Davies, 39, Middleton Road, Dalston, E.8, clerk. The first directors are not named. Secretary (pro tem.): A. J. Markwell. Solicitor: Frank Budd, Devonshire Chambers, 146, Bishopsgate, E.C.2. Registered office: 146, Bishopsgate, E.C.2.

W. J. Henderson & Co., Ltd. (207,768).—Private company. Registered August 8th. Capital £3,000, in £1 shares. Objects:—To acquire the business carried on at 351, Fulham Road, S.W., as W. J. Henderson & Co., to adopt an agreement with W. J. Henderson and A. F. Phelps, and to carry on business as radio manufacturers, factors, merchants, dealers in hardware metal, and other merchants' requisites, &c. The directors are:—A. F. Phelps, 3, The Drive, Hove; W. J. Henderson, 351, Fulham Road, S.W.; R. M. Dillon, 49, Centurion Road, Brighton. Qualification: £10. Solicitors: Darling & Taylor, 7, New Square, Lincoln's Inn, W.C.2. Registered office: 351, Fulham Road, S.W.

Wheatley, Smith & Co., Ltd. (207,788). Private company. Registered August 10th. Capital £1,500, in £1 shares. Objects:—To carry on the business of motor, mechanical, wireless, and electrical engineers, founders, &c. The permanent directors are:—S. M. Wheatley, 86, Nightingale Lane, Wanstead, E.11, radio engineer; J. L. Smith, 22, Nightingale Lane, Wanstead, E.11, radio engineer. Qualification: £150. Remuneration as fixed by the company. Secretary: S. M. Wheatley. Solicitor: Arthur A. Banes, London. Registered office, 170, Strand, W.C.2.

Radio Supply Co., Ltd. (207,815).—Private company. Registered August 11th. Capital £1,000, in £1 shares. Objects:—To acquire the business of dealers in radio apparatus, components, parts, and accessories for radio transmission and reception carried on by R. L. Hazlemen, A. MacKinnon, and J. A. G. MacKinnon, at 22, Medway Street, Chatham, as the "Radio and Electrical Supply Company." The subscribers (each with one share) are:—R. L. Hazlemen, 22, The Paddock, Chatham, Kent, financier; A. MacKinnon, 66, Barnsole Road, Gillingham, marine engineer; J. A. G. MacKinnon, 66, Barnsole Road, Gillingham, electrical engineer. The permanent directors are R. L. Hazlemen and A. MacKinnon. Qualification: £100. Remuneration: £100 per annum divided between them. Secretary: R. L. Hazlemen.

Gregson & Partners, Ltd. (207,843).—Private company. Registered August 12th. Capital £10,000, in £1 shares. Objects:—To carry on business as chemical, electrical, gas, civil, constructional, and mechanical engineers, erecting and manufacturing contractors, &c. The first directors are:—E. P. Taudevin, 74, Endcliffe Edge, Sheffield, engineer; C. Gregson, Edenthorpe, Tapton Park Road, Sheffield, engineer; and J. O. Taudevin, 74, Endcliffe Edge, Sheffield, engineer. The first two are permanent. Qualification of permanent directors, 1,000 ordinary shares; of ordinary directors, 100 ordinary shares. Remuneration (except managing director) as fixed by the company. Solicitors: Broomhead, Wightman & Reed, 14, George Street, Sheffield.

The Nelson Electric Co., Ltd. (207,770).—Registered as a public company on August 8th with a nominal capital of £50,000 in 5s. shares. Objects:—To acquire the business of a manufacturer of, and dealer in valves and electric light bulbs carried on by the Notable Electric Co., Ltd., with all the assets thereof (including any patents to which F. Warner is entitled), and to manufacture, assemble, erect, install, equip, maintain, repair, and deal in wireless, telegraphic, and telephonic apparatus, magnetic and radio-active instruments, &c. Minimum cash subscription: 7 shares. The directors are:—Sir Wm. D. Henry, 60, Bickenhall Mansions, W.1, chairman Anglo-Oriental and General Investment Trust, Ltd.; W. H. Edwards, "Cottingley," Kingston Hill, Surrey, director, Tavoy Tin Dredging Corporation, Ltd.; F. Warner, "The Lawn," Merton Road, S.W.19, managing director Notable Electric Co., Ltd.; A. E. Wallenburg, Berkeley Hotel, W.1, mining engineer (naturalised British subject of Swedish origin). Qualification, £50. Remuneration as fixed by the company. The directors may borrow up to the nominal amount of the capital for the time being. Solicitors: Mawby and Barrie, 101, Salisbury House, London Wall, E.C.2. Registered office: 302, Salisbury House, E.C.2.

Benson Super Power Corporation (2,448 F).—Particulars filed on August 6th pursuant to Section 274 of the Companies (Consolidation) Act. The capital is $35,000,000 in 5,500,000 shares of $10 each ($5,000,000 preferred stock and $50,000,000 common or general stock). The company was incorporated in Delaware on July 13th, 1922, to acquire the property, rights, and privileges of the Benson Engineering Corporation of Delaware. The principal place of business is at Georgetown, County of Sussex, Delaware. The British address is at Crosshaven, Sidcup, Kent, where W. H. T. Gahan is authorised to accept service of process and notices on behalf of the company. The directors are:—W. H. T. Gahan; R. Rowland, "Eastwood," Sidcup; C. W. Oliver, "Okanagan," Sidcup; C. H. Vickers, 274, Elgin Avenue, Maida Vale, W.; and R. F. Rubinstein, 6, Blandford Road, W.4.

Official Returns of Electrical Companies.

Folkestone Electricity Supply Co., Ltd. (51,825).—Capital, £150,000 in £1 shares (100,000 ordinary and 50,000 preference). Return dated April 10th, 1925. All shares taken up and paid for in full. Mortgages and charges, £99,100.

International Wireless Manufacturers, Ltd.—Issue on February 21st, 1925, of £1,300 debentures, part of a series already registered.

L. Weekes, Ltd.—B. T. Crew, C.A., of George Street West, Luton, was appointed receiver and manager on August 1st, 1925, under powers contained in debentures dated May 26th, 1912, and July 16th and November 13th, 1919.

Ledion, Ltd.—W. C. Todd, of 3, Cannon Street, E.C.4, ceased to act as receiver and manager on July 31st, 1925.

Clear Hooters, Ltd.—Particulars filed of £2,500 debentures authorised July 16th, 1925, charged on the company's undertaking and property, present and future, including unpaid capital and calls and liability of members, the amount of the present issue being £1,200.

Llanelly and District Electric Supply Co., Ltd.—Mortgage by sub-demise dated June 16th, 1925 (supplemental to trust deeds dated August 3rd, 1911, November 11th, 1912, November 30th, 1916, and February 9th, 1925, securing £300,000 debenture stock), charged on certain lands near North Dock, Llanelly. Trustees: Century Insurance Co., Ltd., 18, Charlotte Square, Edinburgh.

"Ego" Engineering Co., Ltd.—W. A. J. Osborne, of 119, Finsbury Pavement, E.C., was appointed receiver on August 5th under powers contained in debenture dated May 7th, 1925.

Pressland Electric Supplies, Ltd.—Issue on August 7th, 1925, of £1,500 debentures, part of a series already registered.

Mid-Cheshire Electricity Supply Co., Ltd.—Satisfaction in full on May 14th, 1925, of letter of deposit with title deeds dated July 30th, 1925, securing all moneys due or to become due on special loan account to the Westminster Bank, Ltd.

Receptors, Ltd.—Issue on July 28th, 1925, of £500 debentures, part of a series already registered.

Oriental Telephone and Electric Co., Ltd. (40,691).—Capital, £900,000 in 600,000 ordinary and 300,000 preference shares of £1 each. Return dated July 3rd, 1925. 428,941 ordinary and 188,971 preference shares taken up. £338,660 10s. paid on 149,857 ordinary and 188,791 preference, including £12 10s. paid on 50 ordinary shares forfeited. £279,084 considered as paid on £279,084 ordinary shares. Mortgages and charges, £150,379.

Beck & Moss, Ltd. (69,298).—Capital £2,500, in £1 shares. Return dated March 4th (filed May 5th), 1925. All shares taken up. £525 paid. £1,975 considered as paid. Mortgages and charges, nil.

W. H. Allen, Sons & Co., Ltd. (66,440).—Capital £500,000 in £1 shares. Return dated June 8th, 1925. 408,750 shares taken up. £58,757 paid. £349,993 considered as paid. Mortgages and charges, £49,000.

Cross & Cross, Ltd. (105,754).—Capital £20,000, in £1 shares. Return dated June 23rd, 1925. 10,000 shares taken up. £4,845 paid. £5,155 considered as paid. Mortgages and charges, nil.

Electric Zinc Co., Ltd. (127,838).—Capital £2,000,000, in 400,000 preference and 1,600,000 ordinary shares of £1 each. Return dated December 31st, 1924 (filed June 6th, 1925). Seven ordinary shares taken up. Nil paid. Mortgages and charges, nil.

Hillingdon Screw & Manufacturing Co., Ltd.—Debenture dated July 31st, 1925, to secure £600, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: W. H. Baker, "Hartfield," Mycenae Road, Blackheath, S.E.

W. J. Furze & Co. (121,420).—Capital £35,000, in 9,000 cumulative preference and 26,000 ordinary shares of £1 each. Return dated May 13th, 1925. 9,000 preference and 21,029 ordinary shares taken up. £10,735 paid on 10,735 ordinary shares. £19,294 considered as paid on 9,000 preference and 10,294 ordinary shares. Mortgages and charges, nil.

West Coast of America Telegraph Co., Ltd. (52,114).—Capital, £232,520 in 53,008 ordinary shares of £2 10s. and 100,000 preference shares of £1. Return dated May 26th, 1925. 45,008 ordinary and 100,000 preference shares taken up. £100,020 paid on eight ordinary and 100,000 preference. £112,500 considered as paid on 45,000 ordinary shares. Mortgages and charges, nil.

Chislehurst Electric Supply Co., Ltd. (50,980).—Capital £15,000 in £1 shares. Return dated April 20th, 1925. All shares taken up. £15,000 paid. Mortgages and charges, £7,000.

City Notes.

Reports and Meetings of Electrical Companies; Dividend Results, &c.

Wellman Smith Owen Engineering Corporation, Ltd.

The annual meeting was held on August 11th. Mr. F. N. Pickett, A.M.I.E.E., who presided, said that their hope of maintaining the ten per cent. dividend had been disappointed; after paying an interim dividend of 5 per cent. they were unable to recommend any final dividend. The position was due to the failure of several important and remunerative prospects, and the conditions still indicated necessity for the strictest economy. The company had acquired a controlling interest in its parent company, the Wellman-Seaver-Morgan Company, of Ohio, to prevent the latter company from entering into an amalgamation which seemed likely to prove unfavourable to the Corporation. Negotiations were proceeding for the commencement of the production of special weldless tube-producing machinery and they were encouraged to hope for excellent results owing to recent developments in the manufacture of hollow steel ingots. They had manufactured for a subsidiary, the Wellman Seaver Rolling Mill Co., Ltd., a very modern tube plant which had been installed at Sheffield and was working satisfactorily, and they had also completed the work of assimilating the American designs of coke-oven machinery and gas producers. The prospects for the future depended largely upon the state of the iron and steel industry in this country.

Tyneside Tramways and Tramroads Co.

The half-yearly meeting of this company, whose report was reviewed in our last issue, was held on August 11th. Mr. G. E. C. Henderson, the chairman, said that the traffic receipts had decreased by £1,456, and the profit on the traffic account had fallen to £1,959 from £3,451 for the corresponding period of 1924. The directors did not consider it advisable at present to reduce the services, they were hoping for a revival of employment. The chairman attributed the decrease in revenue to trade depression, unfavourable holiday weather, and motor-'bus competition. While they had added £1,089 to the reserve fund they had spent £1,216 on rolling stock. He regretted that they were unable to recommend a dividend on either preference or ordinary shares. The report was adopted.

South-Eastern Power and Light Co.—This company, which was formed in September last, and acquired certain interests in Alabama from the Alabama Traction, Light and Power Co., has published its first accounts embracing the operation of the properties acquired for the whole of last year, and of the company itself for the last three months of 1924. The gross income is given as $9,810,829 and the net income as $4,911,649. After providing for interest charges, preferred dividends, renewals, obsolescence, &c., there remains a surplus of $1,058,954.

Underground Electric Railways Co. of London, Ltd.—A return covering the period from January 1st to August 8th shows that the traffic receipts of the Common Fund companies (electric railways and motor omnibuses) were £7,863,221, an increase of £438,470 as compared with the receipts for the equivalent period of 1924. On the other hand, the London and Suburban Traction Group (tramways and 'buses) records a decrease of £24,661 in the same period—the revenue being £1,195,055 as against £1,219,716 in 1924.

Burndept Wireless, Ltd.—It is announced that this company, which was formed early this year, has organised the Burndept Wireless Corporation of America with offices in New York. This is the latest subsidiary and the company is now represented in a number of European countries and the Dominions.

East London Railway Co. — The Act transferring the company's undertaking to the Southern Railway Company has now received the Royal Assent. Accordingly steps are to be taken to issue stocks of the latter company to the debenture stockholders and to make the agreed cash payment to holders of consolidated stock. The East London Railway Co. had been in existence for 60 years.

Companies to be Struck Off the Register.—The following companies are to be struck off the register at the expiration of three months unless cause is shown to the contrary:—

Dominion Mica Corporation, Ltd.
Gibeon Magneto Co. (England), Ltd.
International Dowsing Electric Heating and Appliances Co., Ltd.
Lobito, Benguella and Catumbella Light and Power Co., Ltd.
London Electrical Trading Co., Ltd.
Northern Electrical Engineering and Plating Co., Ltd.
Romapac Tramway Construction Co., Ltd.
Tramway (Conduit) Point Syndicate, Ltd.

Fairbairn, Lawson, Combe, Barbour.—An interim dividend of 2½ per cent. has been declared on the preference shares.

Charles Clifford & Son, Ltd.—A dividend at the rate of 10 per cent. per annum, free of tax, has been declared on the ordinary shares in respect of the past half year.

Torquay Tramways Co., Ltd.—The ordinary shares are to receive an interim dividend of 4 per cent., free of tax.

Lancashire Dynamo and Motor Co., Ltd.—The interim dividend is being paid on the preference shares.

Stocks and Shares.

MONDAY EVENING.

THE effect of the recent reduction in the Bank Rate is continuing to make itself felt amongst all the investment markets in the Stock Exchange. Some people hoped, in fact, that the Rate would come down again last Thursday, and that it would be reduced to the round 4 per cent. Although this did not occur, its advent is supposed to be merely delayed, and, until further developments occur in the Money Market, there will be weekly anticipations of a 4 per cent. Bank Rate until this minimum is established. The demand for investment stocks and shares continues to be considerable. For August, the Stock Exchange is decidedly busy. The feature amongst electricity shares is the manner in which the Cable Manufacturing issues continue to forge ahead.

Home Railways are dull. The outlook seems to grow a little more depressing with every Sunday, the day upon which the rift between employers and employés inappropriately grows wider. Jobbers in the market declare that Home Railways are hopelessly unpopular, and admit that it is not surprising, in view of the incessant mutterings of the weekly orators. The rise in the price of domestic coal is a factor that does not make for hopefulness as regards the Home Railway market.

East London Railway quotations have at last disappeared from the pages of the Stock Exchange Official List. Royal Assent has been given to the Southern Railway Act, 1925, and this completes the absorption of the East London into the Southern Railway. Holders of the ordinary stock will receive terms rather better than the last-quoted value of 5¼. With the disappearance of the East London, the tale of the smaller railway lines runs practically to its conclusion. The grouping system may now be said to have attained completion.

Brazilian Tractions spurted 3¼ points to 63¼ upon the anticipation of an increase in the present 4 per cent. dividend. The company is doing well, as was pointed out when the recent report appeared, and, with rubber at a price which will stimulate Para production, the hope is that Brazilian Tractions may receive 5 per cent. dividend. River Plate Electricity ordinary stock has receded several points to 205. British Columbia Electric Railway deferred is 3 up at 106, upon aggressive demand in a market somewhat short of stock. Mexicans are heavy. Madras Electric Tramways drooped to 16s. 6d.; on the other hand, Madras Electric Supply 7 per cent. debenture has risen to 101½.

Anglo-Argentine Tramways preference gained ground upon the suggested acceptance, by a Buenos Aires Municipal Committee, of the company's scheme for the construction of new city subways. The Anglo-Argentine Tramways and an American company both submitted proposals. The Buenos Aires Committee favours that put forward by the British undertaking. If the Municipality agrees, the Anglo-Argentine Tramways should enter upon a lease of new life, for the long friction between company and city will be replaced by a settled agreement. Both classes of preference shares went better upon the news.

Cable manufacturing issues are an outstanding feature of strength. Rises have occurred in British Insulated, Callenders, Henley's, Metropolitan-Vickers, Siemens and Enfield Cables. Higher dividends are expected in each case. The spasm of weakness which attacked this section a fortnight ago is forgotten. Since then, prices have risen from 5s. to 7s. 6d. Nobody talks, to-day, of the raw rubber advance being likely to curtail the profits of those manufacturers. The market is in a condition of mild exuberance. The price of raw rubber has gone back a little, but rubber is no longer regarded as an element of importance in this department.

Movements amongst electricity supply shares are mostly upward. Several prices have recovered the amounts of the interim dividends deducted last week. Notting Hill preference fell 10s. to 9½ upon a few shares coming in, but other members of the London group keep very hard. County of London ordinary strengthened to 53s. 3d.: the company's new 6 per cent. preference have advanced to 1s. 6d. premium. This makes the price 22s. for the fully-paid, and the senior preference are better at 23s., the latter giving the modest yield of £5 4s. 4d. per cent. upon money invested at the current price.

Cable companies' issues are uninteresting: all the excitement centres around the shares of the construction and equipment concerns. Globe ordinary are a little better at 17½.

Marconis, now ex dividend, continue to be a heavy and neglected market. The price has sagged to 25s., and Marconi Marines drooped to 17s. 6d. Wireless shares are out of favour. Marconi 5½ per cent. debenture stock looks reasonably-priced at 103: there is a half-yearly interest payment due next month. In the iron and steel lists, changes are slight and negligible. Babcocks at 53s. retain their handsome rise of last week.

Share List of Electrical Companies.

HOME ELECTRICITY COMPANIES.

	Nom. £	Dividend. 1923.	1924	Price Aug. 17, 1925. (all £)	Rise or fall	Yield p.c.
Bournemouth and Poole	1	13	14	29/xd	+ 1/2	5 0 10
Brompton Ordinary	1	10	10	1 3/4	—	*5 14 3
Charing Cross Ordinary	1	14 1/2	15	4 7/6xd	- 1/6	6 11 10
do. do. 4½ Pref	1	4½	4½	17/-xd	—	5 6 0
Chelsea	1	12	12	1 5/8	-	6 8 0
City of London	1	15	15	45/9	—	5 11 2
do. do. 6% Pref.	1	6	6	23/-	—	5 4 4
Clyde Valley	1	8	8	30/-	—	5 3 3
County of London	1	15	15	58/3	- 6d.	5 14 0
do. do. 6% Pref.	1	6	6	2 /-	+ 6d.	5 4 4
Edmundson's Ordinary	1	7	7	20/6	—	6 1 7
do. 7% Pref.	1	6	7	21/6	—	6 10 3
Elec. Supply Corporation	1	10	10	33/3	—	6 0 4
Kensington Ordinary	5	14	15	12 3/xd	+ 1/4	5 18 8
Lancs. Light and Power	1	7½	7½	25/6	—	5 17 8
London Electric	1	10	10	33/6	+ 6d.	5 19 5
do. do. 6% Pref	5	6	6	5 1/4	—	5 7 10
Metropolitan	1	10	11	37/-xd	—	5 19 0
do. 4½% Pref.	1	4½	4½	17/-	—	5 5 11
Midland Counties	1	5½	6	23/3	—	5 4 4
Newcastle-on-Tyne Ordinary	1	6	7	22/6	—	6 4 5
do. 5% Pref.	1	5	5	18/3	—	5 9 7
do. 7% Pref.	1	7	7	24/6	+ 6d.	5 14 3
Notting Hill 6% Pref.	10	6	6	5 1/2	- 1/2	6 6 4
North Met. Elec. 6% Pref.	1	6	6	22/-	—	5 9 1
St. James' and Pall Mall	5	17½	17½	14 /d	+ 1/4	6 5 0
South London	1	15	15	2 1/2	+ 1/16	6 0 0
South Metropolitan Pref.	1	7	7	1 3/4	—	5 12 0
Urban Ordinary	1	4	4	17/-	—	4 14 2
do. 6% Pref.	1	6	6	19/6	—6d.	6 3 1
Westminster Ordinary	1	15	15	43/6xd	—	6 18 0
Whitehall Elec. Invst. 7½% Pref	1	7½	7½	19/6	—	7 13 10
Yorkshire Elec.	1	8	8	29/-	—	5 10 6

HOME RAILS.

Central London Ord. Assented	Stock	4	4	68	—	5 17 8
Metropolitan	,,	4	5	67 1/xd	—	7 8 2
do. District	,,	3½	3½	44 1/2	—	7 1 4
Underground Electric Ordinary	10	Nil	Nil	2½	—	Nil
to do. "A"	1/-	Nil	Nil	7/-	—	Nil
4o do. Income	Bonds	6	6	98	—	*6 2 5

TELEGRAPHS AND TELEPHONES.

Anglo-Am. Tel. Pref.	Stock	6	6	102½	—	5 15 11
do. Def.	,,	1½	1½	24	—	6 5 0
Automatic Telephone	1	3	6	2 1/8	—	2 18 2
Chill Telephone	5	6	5	5/4	—	*4 13 0
Cuba Sub. Ord.	10	5	5	6 3/4	—	7 8 2
Eastern Extension	10	10	10	17 1/4	—	*5 15 11
Eastern Tel. Ord.	Stock	10	10	172½	—	*5 15 11
Globe Tel. and T. Ord.	10	10	10	17½	+ 1/4	*5 14 1
do. do. Pref.	10	6	6	11	—	5 9 1
Great Northern Tel.	10	22	22	31	—	7 1 11
Indo-European	25	7	8½	41½	—	*5 2 5
Marconi	1	10	10	1 1/4xd	— 1/16	8 0 0
Marconi Marine	1	10	7½	17 6xd	-	8 11 6
Oriental Telephone Ord.	1	12	12	2 1/4	-	*5 12 11
United R. Plate Tel.	5	8	8	7/4	—	5 8 6
Western Telegraph	10	10	10	16 1/4	—	*6 3 1

HOME AND FOREIGN TRAMS, &C.

Anglo-Arg. Trams First Pref.	5	5½	5½	3 7/8	+ 1/16	8 12 6
do. do. 2nd Pref.	5	6	6	8 1/8	+ 1/4	9 6 0
do. do. 5% Deb.	Stock	5	7	71½	—	6 15 2
British Electric Traction Ord.	,,	6	6	11 1/2	—	5 7 2
do. do. 6% Pref.	,,	6	6	104	—	5 15 5
Brazil Traction	100	4	4	63 1/2	- 1/2	6 6 0
Brit. Columbia Elec. Rly. Pcs.	Stock	5	5	88½	-	5 11 9
do. do. Preferred	,,	96/-	96/-	81½	+1	*5 14 0
do. do. Deferred	,,	129/5	129/5	106	+3	*6 2 0
do. do. Deb.	,,	4½	4½	77½	+1	5 9 8
Lond. & Sub. Trac. 5% Pref.	1	2½	Nil	4/6	-	Nil
London United Tram. Deb.	Stock	4	4	42½	—	9 8 4
Mexico Trams, 5% Bonds	—	5	5	62½	—	8 0 0
Mexican Light Common	100	Nil	Nil	25	—	Nil
do. Pref.	100	Nil	Nil	56	- 2	Nil
do. 1st Bonds	—	5	5	61*	-1/2	8 2 8
Yorkshire (West Riding)	1	5	—	17 6	—	5 14 3

MANUFACTURING COMPANIES

Babcock & Wilcox	1	12	12	52/-	—	*4 12 4
British Aluminium Ord.	1	5	10	30/9	—	6 12 6
British Electric Transformer Pref.	1	Nil	7	17/6	—	...
British Insulated Ord.	1	15	15	3 1/2	+ 1/16	4 12 4
British Ord.	1	10	10	1 1/4	—	10 0 0
Callenders	1	15	15	3 3/4	+ 1/16	4 9 0
do. 6½% Pref.	1	6½	6½	23/9	—	5 9 5
Crompton Ord.	1	Nil	Nil	3/8	—	...
Edison-Swan	4/-	10	10	7/1	—	5 2 9
do. 5% Deb.	Stock	5	5	80½	—	6 4 3
Electric Construction	1	10	10	3 3/4	—	6 13 5
Enfield Cable, Pref.	1	7½	7½	1 1/2	-	6 0 0
English Electric	1	5	5	17 9	—	5 14 8
do. do. Pref.	1	6	6	20 6	—	5 17 1
G. n. Elec. Prof.	1	6½	6½	23 6	—	5 10 6
do. Ord.	1	5	7½	24/-	—	6 5 0
Henley	1	13	13	3½	+ 1/16	4 18 ...
do. 4½% Pref.	5	4½	4½	1/4	—	5 6 0
India-Rubber	1	5	5	19/6	—	*5 2 6
Johnson & Phillips	1	10	10	2 1/2	—	4 9 3
Met-Vickers, Ord	1	8	8	24/	+2/6	6 10 8
do. Pref.	2	8	8	2 3/4	—	6 14 9
Siemens Ord.	1	—	7½	1 7/8	+ 1/8	6 4 4
Telegraph Construction	12	20	20	26½	—	4 10 0

* Dividends paid free of Income Tax.

Market Quotations for Chemicals and Metals.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general and they may vary according to quantities and other circumstances.

CHEMICALS, &c.	Price August 18th.	Fortnight's Inc. or dec.
a Acid, Oxalic	per lb.	5½d.	...
a Ammoniac, Sal	per ton	£60	...
a Ammonia, Muriate (large crystal)	,,	£32	...
a Bisulphide of Carbon	,,	...	...
a Borax	,,	£25	...
a Copper Sulphate	,,	£25 10s.	...
a Potash, Chlorate	per lb.	4d. to 4½d.	...
a ,, Perchlorate	,,	5½d.	...
a Shellac	per cwt.	£15 15s.	...
a Sulphur, Commercial	,,	£7 15s.	...
a ,, Roll	,,	£7 15s.	...
a Soda, Chlorate	per lb.	3½d. to 3¾d.	...
a ,, Crystals	per ton	£5 to £5 5s.	...
a Sodium Bichromate, casks	per lb.	4d.	...
METALS, &c.			
b Aluminium, Ingots	per ton	£120 to £125	...
b ,, Wire	per lb.	1/9 to 2/6*	...
b ,, Sheet	,,	1/6 to 2/-	...
p Babbitt's Metal and Anti-friction Metal—			
Grade I	per ton net	£239	...
Grade II	,, ,,	£169	...
Grade III	,, ,,	£95	...
c Brass (rolled metal 2" to 12" basis)	per lb.	9¼d.	...
c ,, Tubes (solid drawn)	,,	1/- to 1/0½	½d. inc.
c ,, Wire, basis	,,	10½d.	...
c Copper Tubes (solid drawn)	,,	1/1½	½d. inc.
c ,, Bars (best selected)	per ton	£98	£2 inc.
c ,, Sheet	,,	£93	£2 inc.
c ,, Rod	,,	£93	£2 inc.
d ,, (Electrolytic) Bars	,,	£67 15s.	...
d ,, ,, Sheets	,,	£148 10s.	...
d ,, ,, Wire Rods	,,	£77 15s.	...
d ,, ,, H.C. Wire	per lb.	9½d.	...
f Ebonite Rod	,,	to 2/6	...
f ,, Sheet	,,	2 3 to 2/6	...
a German Silver Wire	,,	2/3	...
h Gutta-percha, fine	,,	2/9	...
h India-rubber, Para fine	,,	3 2	1½ dec.
i Iron Pig (Cleveland Warrants)	per ton.	nom.	...
i ,, Wire, galv. No. 8, P.O. qual.	,,	£21	...
g Lead, English Pig	,,	£29	1's. inc.
g Mercury	per bot.	£13 12s. 6d. to £13 17s. 6d.	2s. 6d. dec.
e Mica (in original cases) small	per lb.	8d. to 8/-	...
e ,, ,, medium	,,	4/- to 8/-	...
e ,, ,, large	,,	10/- to 20/- & up.	...
p Phosphor Bronze, plain castings	,,	1/3½	...
p ,, ,, drawn bars & rods	,,	1/8	...
p ,, ,, rolled strip & sheet	,,	1/9½	...
p ,, ,, wire	,,	1/8½	...
e Platinum	per oz.	£2o	...
j Silicium Bronze Wire	per lb.	1/0½	...
r Steel Magnet (n bars	,,	7½d.	...
e Tin, Block (Enguah)	per ton.	£156 15s. to £257 6s.	£7 10s. to £7 15s. dec.
a Wire, Nos. 1 to 18	per lb.	9/11	...

*For 1 cwt. lots. Special quotations against definite specifications

Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare
h Elward Till & Co.
i Bolling & Lowe.
j Richard Johnson & Nephew, Ltd.
k P. Ormiston & Sons
e Johnson, Matthey & Co. Ltd.
e C. Clifford & Son, Ltd.
r W. F. Dennis & Co.

Standard Guarantees for American Accumulators.—A standard ninety-day guarantee on storage batteries and a standard rating for radio "A" batteries were adopted at the convention of the American National Battery Manufacturers' Association lately held in Chicago. At a previous meeting a standard rating for radio "A" batteries was adopted which was based on a continuous discharge of one ampere, starting with a specific gravity of 1.285 and a temperature of 85 deg. F., continuing the discharge until a voltage of 1.75 per cell is reached. Due, however, to the fact that many batteries on the market are rated on a basis of intermittent discharge, it was decided to adopt a second rating which provides for a discharge of ¾-ampere per positive plate, the discharge to be for four hours, followed by a rest period of twenty hours, then discharged for four more hours, and so on until the voltage per cell has fallen to 1.75. It was recommended that these ratings be placed on the name plates of all radio "A" batteries. The idea of a standard warranty includes the prospects of eventually selling all batteries on the same basis on which motor vehicles are sold, where the manufacturer sells his merchandise on its reputation and makes good defects in material and workmanship only. The warranty is as follows:—

"We guarantee each new battery manufactured by us to be free from defects in material or workmanship under normal use and service; our obligation under the guarantee being limited to making good at our factory any part or parts thereof which shall, within ninety (90) days after delivery of such battery to the user, be returned to us with transportation prepaid, and which, upon examination, shall disclose to our satisfaction to have been defective. This guarantee shall not apply to any battery which shall have been repaired or opened outside our factory or duly authorised service station, nor which has been subject to misuse, negligence, or accident.

An Electrically Driven Stone Quarry.

The Leckhampton Quarries Co.'s Undertaking.

THAT the Leckhampton Quarries Co., Ltd., is up to date is indicated by the fact that all the plant and machinery of this Gloucestershire undertaking is electrically operated. Moreover, the company generates its own electricity by means of a new type of 3-phase alternator which was described in our May 15th issue.

The power station contains two 250-b.h.p. Premier 4-cylinder gas engines, fig. 2, each driving a Hunt 440-volt, 200-kVA, 50-cycle, self-paralleling alternator, fig. 1, built by Messrs. Sandycroft, Ltd. The two sets of gas producers were supplied by Messrs. Crossley Bros., and the auxiliary plant includes an air compressor and receiver and furnace exhaust fans required for starting the plant, driven by a small oil engine; a 7½-h.p. motor drives the fan and pump of the Heenan & Froude cooler for the main engine circulating water, while water is fortunately available in abundance at a sufficient head from neighbouring springs to supply the gas scrubbers, engines, and storage tanks.

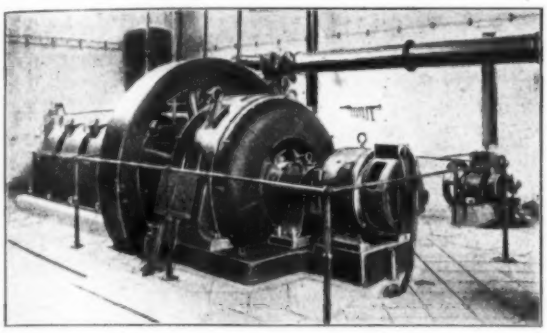


Fig. 1.—A Hunt 200-kVA Alternator.

The 8-panel 4-wire switchboard is by the Metropolitan-Vickers Electrical Co., the supply being at 440 volts, 3-phase 50 cycles to motors, and at 250 volts between each phase and neutral for lighting.

The limestone quarry is on a hill at a distance of one mile from the power station, and for supplying motors at the hill workings the voltage is stepped up at the power house to 2,200 volts and the power transmitted by an underground cable to a sub-station on the hill where step-down transformers reduce the pressure again to 440 volts. The h.p. Henley cable is paper-insulated, lead-covered, and steel-armoured. A 4-pair core cable is laid underground from the power house and offices to the hill sub-station for telephone communication and also for signalling by electric bells between the hill workings and marshalling yard at the foot of the incline.

The Swedish 3-phase step-up and step-down transformers for this supply are in pairs, each pair being of a capacity of 220 kVA coupled in parallel. The hill sub-station supplies a haulage motor, two 35-h.p. motors driving exhaust fans for the kilns, a fuel elevator motor (4 h.p.), a centrifugal pump motor (1 h.p.), and the kiln furnace blower motor (7½ h.p.).

The necessary lighting for the night shift is furnished at 250 volts off each phase and transformer neutral. A considerable amount of water is required for the hill workings and, as no natural supply is available at that altitude, water is pumped up from a pond at the power house level to storage tanks on the hill by a 3-throw lift pump driven by a 3-h.p. motor.

The main and tail haulage gear (by Messrs. Bullivant) controls the descent of trucks loaded with limestone and the raising of trucks which are sometimes empty and sometimes loaded with fuel for the kilns. The rail gauge is standard 4 ft. 8½ in. and the loaded trucks on reaching the marshalling yard at the foot of the incline are drawn by steam locomotives to the G.W.R. main line. The maximum loads for which the haulage gear was designed were two 6½-ton G.W.R. trucks, each loaded with 10 tons of stone (33 tons) down, and either 23 or 15 tons up, according to whether fuel or another load was being raised. This gave a general out-of-balance load of from 10 to 18 tons in favour of the drive by gravity, but as the incline is a varying gradient, there are certain lengths of the track where driving power is necessary; for instance, when the descending load is nearly on the level and the ascending load is on the steepest gradient (1 in 5). Also considerable torque is required to start the loaded trucks on the level before commencing the descent. The rate of travel is 5 miles per hour.

After the haulage plant had been in operation a few months it was found advantageous to load the trucks with the exact quantities of material ordered, and as such loads varied and were frequently light, the assistance by gavity was reduced and more load thrown on the motor. The motor is a single-speed cascade machine of 80 b.h.p., built by Messrs. Sandycroft, Ltd., to Mr. L. J. Hunt's design, and has proved quite capable of standing short overloads up to 50 per cent., and momentary overloads up to 100 per cent. The speed is controlled by mechanical brakes on the haulage drums and electrical regenerative braking on the motor when the speed exceeds synchronous speed. The controller regulates the resistance in the stator circuit, and when the motor is returning current to the line all controller resistance is cut out. A Heenan & Froude hydraulic brake forms part of the haulage equipment as a standby and safeguard in emergency. The heights above sea level of the hill workings and the power house are 850 ft. and 350 ft. respectively; consequently, the height through which the haulage operates is 500 ft.

On the occasion of our visit there were in operation 198 h.p. of motors of various makes connected to the stoneyard machines, and an overhead travelling cane now nearing completion will take a further 158 h.p., while hydrating plant is shortly to be installed which will require 120 h.p.

The generating plant was guaranteed to give full load at a consumption of 1.35 lb. of anthracite (of 14,500 B.th.u. per lb.) per kWh; also 1.65 lb. at ¾ load and 2.2 lb. at ½ load. We are informed by Mr. H. D. Wilkinson, consultant to the quarry proprietors, that on a full day's test run with fuel of 14,670 B.th.u. per lb., the consumption was 1.27 lb. fuel per kWh at 92 per cent. of full load and 0.98 power factor; 1.45 lb. at ¾ load and 1.53 lb. at ½ load, as against the guaranteed figures (corrected for calorific value) of 1.33, 1.63, and 2.17 respectively. These figures were obtained after deducting the power used for engine cooling (6.6 kW) from the total output, and prove that the plant has a high efficiency in respect of each of the three generating stages in producing electricity from coal.

Interesting Coal-handling Equipment.—An example of modern coal-handling equipment recently installed by Messrs. Fraser & Chalmers engineering works (General Electric Co., Ltd.), at the new power station of the West Gloucester Power Company at Lydney, possesses interesting features, inasmuch as the coal may be conveyed by it direct from the pit head to the boiler-house bunkers; provision has been also made for dealing with coal brought from adjacent collieries by rail. From the colliery screen house a 24-in. inclined Robins belt conveys the coal to a junction tower situated near the end of the boiler house; the coal here changes its direction and, still ascending, is conveyed right over the top of the boiler-house bunkers; the conveyors run at a speed of about 250 ft. per minute and have a capacity of 100 tons of coal per hour. The cast-iron rollers are mounted on hollow shafts lubricated with solid grease, whilst the "Durabelt" consists of graduated plies of cotton duck cemented together with rubber compound, or "friction" as it is called, the whole being enveloped in a rubber cover; the top cover is further reinforced by means of a special open fabric, which is used to key the top cover to the body of the belt. These belts were individually designed with regard to weight of material, plies of cotton duck, and composition of rubber, to meet the particular services for which they have been installed. The coal on reaching the boiler house is conveyed by a horizontal belt over the bunkers, into which it is distributed by a travelling tripper.

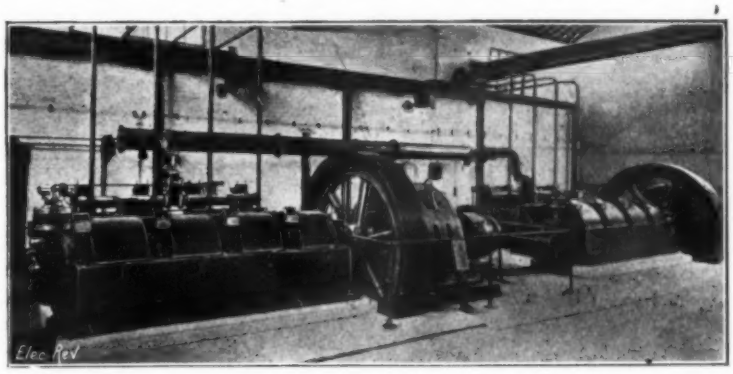


Fig. 2.—Premier 250-b.h.p. Gas Engines.

Breakdowns and Failures of Electrical Plant and Equipment.

CONTAINED in the Technical Report for 1924 of the British Engine, Boiler and Electrical Insurance Co., Ltd., are many accounts of breakdowns and failures selected from the casualty list of the year, either because of some interesting peculiarity or as suggestive to makers and users of such plant. From the electrical and allied sections we cite the following cases.

An instance of turbine blading troubles was discovered in a 500-kVA turbo-generator running at 3,000 r.p.m. and working at a steam pressure of 125 lb. per sq. in. and a temperature of 450 deg. F. The turbine was of the Curtis type, with three wheels each containing two rows of blades. As it was noticed that the set failed to give its rated output with the normal steam supply, the turbine was opened out. It was found that the two rows of blading on the first rotating disk were indented at the steam side, the marks being in some cases ⅛ in. wide, and the blading of the corresponding inlet nozzles was indented at the edge adjacent to the first row of the rotor blading; the intermediate guide blading for the first wheel also was bruised. The damage, which was not caused by distortion, and which did not bear the appearance of having been caused by water, was evidently brought about by the jamming of some foreign substance between the stationary and the revolving blades; the strainer was found in order and no loose part could be found, nor could the cause of the damage be definitely traced. It was seen, however, that there were two small blowholes at the bottom of the cylinder at the high pressure end, the holes being about ¾ in. in diameter and ⅛ in. in depth. It is possible that either small portions of this porous metal or a piece of a core nail from some other part of the casting may have become detached and caused the damage. This case exemplifies the value of the recommendation that a turbine should be opened out at least once a year for examination. It is by no means uncommon, on a turbine being opened up, to find that the blading is damaged.

A case where an alloy ring, for retaining the ends of the armature conductors connected to the commutator, suddenly broke axially along its whole length and caused the wrecking of the generator of a 1,000-kW turbo-generator, is recorded. After being at work carrying half the full rated load, the machine was being shut down in the usual manner; the load had been gradually reduced, the controlling switch for the generator opened, and the steam valve tripped immediately afterwards by the engine driver, who had been awaiting the signal from the switchboard attendant; steam was then shut off. The governor was at the time in good order and no observable rise in speed took place when the switch was opened. When the speed had fallen to about 1,000 r.p.m. the trouble occurred.

The broken ring, which at first continued revolving with the shaft, opened out with the centrifugal force of the portions near the line of cleavage and of the contained windings, and, after shearing the set screws by which a ventilating fan was secured to it at one end, struck the cast-iron field frame, fracturing this also; fragments of the frame were hurled in various directions over the engine house, while the ring itself catching on the field frame was opened still wider and flung clear of the machine with only small pieces chipped off. The connections between the armature winding and the commutator, no longer held down, flew outwards and were broken; the field coils and the armature winding were damaged beyond repair. Fig. 1 shows the end of the field frame after the accident. The ring was 42 in. in diameter and 17¼ in. in width; it was pressed on to the armature core at one end, and near the other rested on lugs formed on a drum beneath the conductors. A flange, 3½ in. deep, was cast at the end near the lugs to form one side of the fan, which was situated between the ring and the commutator, the runner of the fan being spigoted into the base of the flange, where it was further secured by fifteen ⅝-in. steel set screws. Axial and circumferential movement were prevented by twenty dowel pins, screwed into the ring and sliding inside sockets cored in the lugs on the lower drum. The thickness of the body of the metal was about 1 in.; this tapered down to .55 in. near the armature core, where the thickness of the lip was .375 in. The surface speed of the ring, 13,750 ft. per minute, was by no means excessive; the stress at the inside, caused only by its own centrifugal force, would not have exceeded 2.5 tons per sq. in. and at the inside of the flange 2.75 tons per sq. in. The total running stress would have been well within the safe working limit for a sound casting.

An investigation was carried out to determine the cause of the failure, and microscopic examination showed that the material was of an excessive grain size. All the specimens examined showed a large amount of oxide inclusion and a number of small blowholes, which were distributed throughout the metal; in addition, there were, locally, cavities of appreciable dimension. Considerable difficulty was experienced in polishing the specimens owing to foreign matter, which exuded from the cavities and scratched the surface. Sections, examined both along the principal axial fracture and along a small longitudinal crack which branched off from this, showed that the fractures were in several positions inter-crystalline in character owing to the local weakness at the boundaries caused by defects. In several places the cracks passed through large cavities and areas containing the gamma compound; one area of this nature is shown by a photomicrograph to possess a crack commencing at a cavity in one of the white-coloured grains, and running into the fractured edge at a similar grain. The material proved defective owing to the metal having been cast at too high a temperature and allowed to cool too slowly.

In another case, perished and brittle insulation on the armature coils resulted in a breakdown on a 1,500-kW, 0.8 power factor turbo-alternator, three-phase, 11,000 volts, 50 cycles, 1,500 r.p.m. The stator insulation was uniform throughout, the insulation on the conductors and the partition insulation in the slots between the two rows of conductors not being reinforced at the terminal ends. A serious burn-out occurred owing to an arc being set up in the stator end windings, between the top two conductors in the first slot connected to one of the terminals on the machine; the arc jumped to earth at one of the clamping bolts, severing the leading-out conductor and the end turns of the conductors of the neighbouring slot on the same phase, across which the former was bound. The machine caught fire and the flames, fanned by the draught, were carried round the windings; all the insulation, at the exciter side, of both the stator and the rotor was burnt com-

Fig. 1.—The 1,000-kW. Damaged Generator.

pletely through. The complete generator had to be returned to the makers for re-winding. The burn-out was caused by the insufficiency of the partition insulation between the two rows of conductors in a slot.

An accumulation of dirt in the rotor windings resulted in a breakdown on a 750-kW turbo-generator, 400 V, three-phase, 50 cycles, 3,000 r.p.m. It was noticed, immediately before stopping time, that undue vibration was taking place. On the following morning considerable difficulty was experienced in maintaining the alternator voltage, and smoke was seen issuing from the air outlet. When the end covers of the alternator were removed, it was seen that the smoke was coming from the ventilating ducts in the rotor core; this continued for four hours. A test of the rotor windings, made after the smoke had subsided, showed the very low insulation resistance of 0.001 megohm. The rotor was returned to the maker's works, where the end bells were removed, and the coils examined and tested. The tests this time showed perfectly normal results, but it was discovered that a short circuit had taken place between the lower turns of a group of coils and the leading-out strip to the slip rings. The improved test had come about owing to the removal of the end bells; this had allowed the faulty turns, which normally were pressed against the leading-out strip, to spring outwards and create a clearance

space. All the windings of the machine had suffered from the accumulation of dirt, and the insulation of the rotor was found to have perished considerably. The dirt consisted mainly of lime and iron, the latter being present, in a large measure, in the form of sulphide. The air intake for the machine was in the vicinity of the ash tip and the coal chute for the boilers, the opening being only protected from the dust-laden atmosphere by means of sheets of perforated metal. The rotor was completely stripped and re-wound, and the installation of an air-filter was recommended.

A breakdown on a 400-kW turbo-generator, four-pole, compound wound, 525 volts, 1,500 r.p.m., was attributed to shrinkage of the insulation and the resulting chafing; a short circuit developed between a top and a bottom bar in one of the armature slots. Several bars had to be removed before the faults could be located; after the faulty bars were taken out, the insulation was tested and found to be unsatisfactory. It was decided to re-wind the armature entirely and to renew the slot insulation.

A 500-kW motor converter converting to d.c. at 460/550 V, 1,040/910 A, from three-phase, 6,600 volts, 50 cycles, 53 amps., was subjected to a breakdown which took the form of a "short" inside one of the slots between the two bottom conductors, one of which was an end conductor connected to the terminals; the fault occurred after the set had been in operation for three or four hours. At that time it was discovered that the charging resistances were burnt out; the resistances were replaced and all the conductors, together with the insulation of the faulty slot, were renewed. Two months later, while the set was being started, a humming noise was heard when the oil switch was closed; the machine was found to have broken down again. The breakdown occurred, as before, between two bottom conductors, one of which was an end conductor but on a different phase to that which had failed previously. On this occasion the charging resistances were found in order and, with the exception of the faulty bars, the insulation resistance between each conductor and the remainder, and also to earth, exceeded 100 megohms. It appears probable that the second fault developed as a result of the insulation being strained while the charging resistances were out of commission. The insulation of the end conductors was similar to that in the remainder of the machine and not adequate. In view of the high pressure between the turns, and of the pressure rise which is to be expected at times of switching or on the occurrence of a surge, the insulation of the end turns should have been reinforced.

Trouble as the result of a rotary converter being worked at a low power factor in order to obtain a d.c. pressure regulation resulted in a shut down on a 300-kW, six-pole, shunt-wound interpole rotary converter, designed for converting six-phase, 50-cycle alternating current at 0.98 power factor to direct current at 520 volts. The machine was used for supplying at 420 volts, the transformer windings being arranged to suit.

A burn-out of this machine took place at the slip-ring end, between the end of the core and a binder, confining the overhang of the windings, which was ⅛ in. from the end of the core. It could be seen that all the conductors of one slot and all but one of the neighbouring slot had been melted through, and that nine other coils were burnt owing to the flame being carried round the periphery; molten copper, which had been thrown out, had collected under the formers of the field coils; the intersegmental micas and some of the commutator bars had suffered also.

The trouble commenced with the overheating of the coils connected to the slip rings; one of these was situated at the centre of eight adjacent burnt-out coils and the arc evidently started in this. Under the working conditions of this machine, although the output on the direct-current side may be kept below the rated value, the current in the windings referred to may still be excessive, as it was in this case.

The case of a 330-b.h.p., vertical, water-cooled, squirrel-cage, 3-phase induction motor, 2,750 volts, 40 cycles, 1,180 r.p.m., in which trouble was experienced owing to the rotor and stator cores coming into contact is of considerable interest. The motor, which was totally enclosed, had a water-jacketed stator core. The jacket was divided into two sections, each provided with longitudinal ducts connected so as to afford a zigzag path for the water, which was drawn from the rising main. The air in the motor was circulated by means of a fan, and the heat transferred to the water by means of longitudinal ribs cast on the outside of the jacket.

On the motor being dismantled after the trouble, it was found that the jacketed stator core had become loose in the outer frame on account of wear at the surfaces where the jacketed core made contact with the outer frame. The fixing was effected by means of sixteen machined pads cast on the inside of the outer frame, eight at each end: these bore on corresponding T-shaped lugs, 2 in. long axially, cast on the outside of the jacket; the bottom pads were secured to the lower end cover by set screws which prevented turning and axial movement. Owing no doubt to vibration, the set screws had worked loose and allowed movement of the interior portion of the stator frame, the lugs being originally a loose fit inside the pads. As a result of the cumulative movement which occurred, both the T-shaped lugs and the machined pads were worn, in some cases by as much as 30 mils. As defective joints were found in the rotor windings, it is probable that uneven current distribution in the rotor bars was in a large measure the cause of the vibration. New bars were fitted to the rotor and new end rings cast on. The stator winding, which had suffered somewhat from oil and water, was thoroughly dried, cleaned and re-varnished; after this it showed a satisfactory insulation resistance and withstood a pressure test of 4,000 volts for one minute. The arrangement was not considered satisfactory on account of the lightness and ill fit of the fixing lugs; it was found possible, however, to effect a satisfactory repair by locking the set screws securely and affixing additional set screws on the periphery of the outer frame and passing through the pads; these, after the jacket had been set central, were secured by locking plates to the outside of the casing. A year later, on the occurrence of a second failure, it was found that one of the stator coils was "earthed." Examination showed that the water jacket was very nearly choked with deposit, causing the motor to overheat. Considerable difficulty was experienced in cleaning out the water jacket, and finally the use of acid was resorted to. The stator winding was completely rewound and improvements were made to prevent oil being drawn into the motor through the bearings.

In another instance the shaft of a 220-b.h.p., three-phase, slip-ring type, induction motor, 400 volts, 50 cycles, 364 r.p.m., broke close to the housing at the pulley side of the inside bearing of the machine. The outer bearing was broken to fragments but the inside bearing sustained little damage. The trouble arose from the entire absence of a fillet at the change of diameter, where the journal joined on to the oil thrower; this led to a concentration of stress there. The shaft was further weakened by the presence of an area of segregated matter containing a considerable quantity of sulphur; it could be seen clearly from the progressive markings on the fractured surface that the failure had emanated from this locality.

Several records are shown of static transformer breakdowns. In one interesting case two 1,000-kVA transformers, arranged Scott-connected, primary 6,600 V, three-phase, 50 cycles, 177 amperes, secondary 2,300 volts, two-phase, 435 amperes, were arranged with the primary windings of each transformer in two sections wound concentrically, the secondary windings being sandwiched between these; and each set of windings traversed the full length of the core. The primary and secondary of the transformers were each controlled by automatic oil switches set to operate with full load current. Both switches were fitted with auxiliary contacts, charging resistances being placed between the main and the auxiliary contacts. The transformers were situated at the generating end of the system close to the alternator, while the switching on or off was effected each day with the secondary on open circuit and the alternator generating full voltage. The insulation, of the transformer connected to the 86 per cent. tapping, failed half-an-hour after being switched on and while the combined load was only 200 kVA, the full-load current having at no time been exceeded. It was found that arcing had taken place between the top turn of one of the inner sections and the iron core; several of the neighbouring turns were charred, the insulating cylinder, on which this coil was wound, pierced, and the core burnt locally by the arcing; the insulating cylinder on which the secondary was wound had also collapsed at the bottom. Considerable movement of the windings had taken place owing to their lack of rigidity and in consequence the insulation of the top turn of the inner primary winding on the second limb had been bared owing to the winding having been forced against the supports; the insulation elsewhere was in good condition. The dielectric strength of the oil was, when tested, found satisfactory, the oil being free from acidity and withstanding 22,000 volts across a 0.15 in. gap. The trouble appears to have arisen from the insufficient support of the windings and to shrinkage having allowed these to move and cause a breakdown of the insulation of the end turns, the resultant arc causing the remaining damage. As the makers considered it possible that the insulation of the end turns was damaged during the switching operations, it was arranged that in the future the primary of the transformers should be kept permanently in circuit. The movement of the windings necessitated the complete re-winding of the inside section of the primary of both limbs, and, owing to damage to the insulating cylinders on which the secondaries were wound, the replacement of the cylinders involved the complete re-winding of the secondaries.

Among the breakdowns recorded in the miscellaneous electrical equipment is the case of an oil-immersed switch, designed for working on a 75/125-ampere, 440-volt, three-phase, 50-cycle circuit, through a three-phase transformer, the star point on the low-pressure side being earthed. The switch was of the pillar type, the contacts being immersed in the usual manner inside a cast-iron tank; the tank was attached to a cast-iron bonnet containing the operating mechanism and electrical connections, an ammeter being connected to one of the outgoing phases. The tank and bonnet were separated by a three-ply wooden partition, pierced for the connections and operating bars; this would prevent any part of the upper chamber, which might become detached, from dropping into the oil tank. The switch was fitted with one no-volt and three overload trips, but was not provided with a gas vent. The oil in the tank had been replaced two months prior to the failure, which occurred at a time when there was only one 10-b.h.p. motor in operation on the circuit controlled by the switch, the motor being used for driving mechanical stokers.

An explosion occurred inside the switch, resulting in the tank bursting and the ammeter being blown out of the panel and destroyed. One of the overload coils was completely burnt

out and the aluminium bar for operating the overload trips was broken; the inside connections of the switch also bore evidence of the arcing which had taken place.

It was established that care had been taken to fill the oil tank to the correct level, but that the aluminium overload trip bars of other switches had been found broken on previous occasions at times of examination; a breakage of this nature could readily lead to a short circuit owing to the congested arrangement of the interior connections of the switch. At the time of the explosion an electric crane was working in the vicinity, but off another circuit. The evidence points to the fact that the trip bar was broken prior to the mishap and came into contact, possibly owing to vibration, with one of the ammeter connections. The aluminium trip bar, which was earthed, at once formed a short-circuit path for one of the phases through earth, causing current to pass through the overload trip coil in this phase, burning it out. The current, which would have passed through the overload coil, was unable to trip the switch owing to the bar being broken; the arc to earth, resulting from the short circuit, evidently developed into an arc between phases and spread across the connections inside the switch, igniting accumulated gases and causing an explosion.

High-Pressure Steam Turbine Development.

Some Swiss Opinions and Achievements.

AT a recent meeting of the Association Suisse des Electriciens, in Berne, M. Ad. Meyer, chief engineer of Messrs. Brown, Boveri & Co., Baden, read a paper on "Recent Installations of High-Pressure Steam Turbines," in the course of which he pointed out that at the price at which it was then being offered for delivery in large quantities at Basle, coal as fuel could successfully compete with water power in the generation of electrical energy in Switzerland. The author stated that according to various authorities the cost of fuel, including depreciation, interest, and general expenses, was estimated in the United States to amount to 75 per cent. of the total cost in the case of power stations with an output of several thousand kilowatts. Although in Switzerland coal was more costly than in America, and consequently entered more largely into the operating expenses, he based his calculations for the sake of simplicity on the American figure.

At the present time boilers were being constructed in Switzerland to deliver steam at a pressure of 35 atmospheres and a temperature of 400 deg. C. His company, in utilising steam at this pressure, was now able to supply turbines under a guarantee that, using coal yielding 7,500 calories per kilogramme and with a suitable condensing installation, the fuel consumption would not exceed 0.47 kilogramme per kilowatt-hour at the generator terminals. Estimating coal at 4 centimes per kg. (about 32s. per metric ton), the cost would be equal to only 1.88 centimes per kWh (at the present rate of exchange 100 centimes would be worth approximately 9.6d.). Figured on the 75 per cent. basis mentioned above, the total operating cost of a high-pressure, steam-operated power station would work out at approximately 2½ centimes per kWh for a co-efficient of current utilisation, that is to say, a load factor, of 60 per cent.; but if it was assumed that the load factor was 40 per cent., the production cost of a steam station would be 3.65 centimes per kWh, and with a load factor of only 20 per cent. the cost would be 5.4 centimes, figures which, in the author's opinion, could be favourably contrasted with those of a hydro-electric station. Such figures could, however, only be attained by the adoption of a much higher steam pressure than had hitherto been in general use. Although, having regard to the large quantities of coal that would need to be imported, it might be questionable whether in a country like Switzerland it would not be preferable to rely on hydro-electric stations, there were many instances in which steam at not unduly high pressures was required, in which it was undoubtedly economical to produce steam at a higher pressure than necessary for heating and other purposes, and to reduce the generated pressure by the expedient of utilising it for driving turbines. An installation of this kind had recently been completed at the Brown, Boveri works in Baden, which would shortly be heated throughout by exhaust steam. The installation comprised boilers designed to produce steam at a pressure of from 15 to 18 atmospheres and a temperature of from 350 to 380 deg. C. for power purposes and for the turbine-testing department. The steam was first used to drive a turbine, the expansion being there utilised to the condensation pressure, the latent steam heat being then transferred to the water circulating in the condenser; the water when it emerged from the latter at a higher temperature was circulated by pumps through the heating radiators, from which it returned to the condensers to repeat the cycle of operations. In order to meet heating requirements which varied in accordance with the external temperature, the water must emerge from the condenser at temperatures ranging from 50 to 90 degs. C. Taking as a typical example working live steam at a pressure of 18 atmospheres and a temperature of 350 deg. C., and an absolute back pressure of 0.5 atmosphere, the water circulated for heating purposes could be heated up to about 80 deg. C.; under such circumstances each kilogramme of steam would contain 753 calories. In the case of an ideal turbine the expansion (adiabatic) would absorb 166 calories from the steam, leaving 587 calories per kg. in the exhaust steam available for heating purposes. Coming down to realities, however, the author pointed out that, taking turbine efficiency at 74 per cent., and having regard to mechanical losses and the energy lost by radiation, the calories actually converted into mechanical energy by the turbine would only be 118, which would leave 635 calories per kg. (753—118) in the exhaust steam, or 85 per cent. of the energy of the live steam.

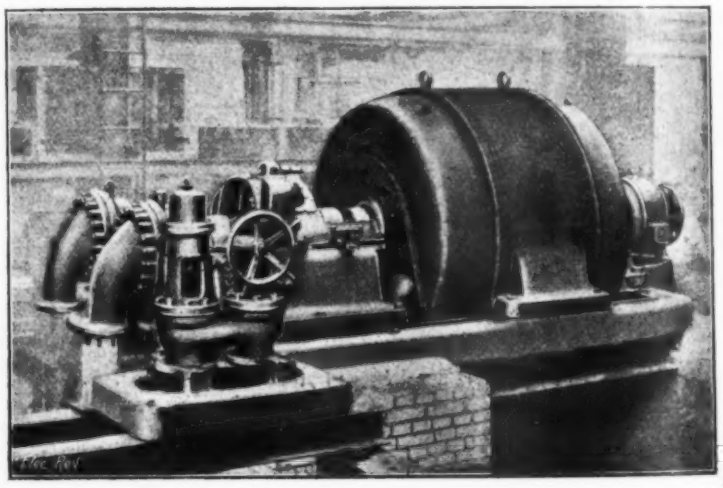


Fig. 1.—A High-pressure Brown, Boveri Steam Turbo-alternator Set.

With a turbine steam consumption of 7 kg. per kWh, and a boiler having a vaporisation co-efficient of 8.75, the fuel consumption would be equal to 0.8 kg. per kWh. Owing to the relatively high temperature at which the condenser water utilised as feed water reached the boiler, such a favourable vaporisation co-efficient could be expected without demanding too high a boiler efficiency, which under such conditions would not exceed 77.5 per cent. With coal at 50 francs (£2) per metric ton, the 7 kg. of steam per kWh would cost 4 centimes. As only 18.5 per cent. of the useful energy would be taken for power purposes, the remainder being utilised for heating purposes, the cost per kWh would fall to . . . . 4×18.5/100=approximately 0.75 centime.

The double utilisation by back-pressure turbines of the energy of steam would, however, be rendered difficult by reason of the fact that the demands for calorific energy and for driving power would not always be equivalent to the requisite ratio. Whether one desired it or not, means had to be provided of storing up one of the forms of steam energy. The usual method being somewhat onerous and low in efficiency, the plan of using a direct steam-driven turbine in place of one of the back-pressure type had been tried. In this way only a portion of the steam supply would be utilised in the turbine to a point of expansion at which the pressure and temperature corresponded to the heating installation requirements, the other portion being allowed to expand on its way to the condenser. In this way it was possible during periods of excess power demands to draw steam for the turbine from the condenser supply. Inversely, when a greater amount of steam was required for heating than for power, the lower steam pressure stages of the turbine could be cut out and the still live steam, the pressure of which was reduced by a by-pass valve, exhausted into the heating system pipes.

As a result of the high-pressure steam now available it had been made possible to replace the direct steam-driven turbine with a true back-pressure turbine in which all the exhaust steam was utilised for heating purposes. In cases where there was nothing to hinder the selection of live steam characteristics it was possible to determine the specific turbine steam consumption to ensure the requisite division of steam for power and heating purposes and the desired degree of back pressure.

Since they commenced the construction of steam turbines the Brown, Boveri Co., the author stated, had supplied normal condensing plant to the extent of, roundly, 4 million kW, an analysis of which showed the average live steam pressure to be 12 atmospheres, although in certain cases 20 atmospheres had been attained; the steam temperature had, however, never exceeded 375 deg. C. Progress was now being made in the direction of higher pressures: The North Tees (England) station* had for some years been working turbines with steam from Babcock boilers at 33 atmospheres and 370 deg. C.; a paper mill in Sweden was equipped with two "Atmos" boilers, one working at 50 atmospheres and one at 100 atmospheres, while two sets of 80-atmosphere plant were in course of construction in America. Finally, the author mentioned that the Brown, Boveri Co. had just completed a 1,750-kW turbo-alternator for the power station of the Société des Centrales Electriques des Flandres at Langerbrugge, Belgium (the machine was being submitted to test) which was designed to utilise steam at a pressure of 51 atmospheres and a temperature of 442 deg. C. The turbine ran normally at 3,000 r.p.m., but it would drive the alternator by means of gearing at 1,500 r.p.m. Fig. 1 illustrates the machine and it will be noticed that the turbine is so inconspicuous that it is hardly visible at first sight. Steam is fed to the turbine through a nest of tubes instead of the usual single pipe. The author stated that, in his opinion, there was a big future for the joint running of electric power stations and steam heating and cooking installations, which with high-pressure steam could be operated on a very economical basis.

The Hydro-Electric Power Commission of Ontario.

Seventeenth Annual Report.

THE seventeenth annual report of the Hydro-Electric Power Commission of Ontario, covering the year ended October 31st, 1924, is a record of continued and, in some cases, rapid progress. As we have said with regard to previous reports, the contents do not lend themselves to complete treatment in a small space (the report contains over 640 pages), we are only able to indicate the contents, and note the principal developments.

The consolidated accounts of the 241 municipalities (as against 224 in the preceding year) which take supplies of "Hydro" power on "cost contracts" for detail distribution, show a total revenue of $18,798,723. Against this was charged a total of $17,634,813, representing the cost of power, operation and capital charges, and depreciation, leaving a surplus of $1,163,910. Practically all the municipalities operated at a profit, there being only 16 showing deficits which in the aggregate amounted to $18,552. The net assets of the whole of the systems were valued at $72,884,271, and there were liabilities of $43,065,052, reserves amounting to $13,518,402, and surpluses totalling $16,300,817. The percentage of net debt to the total assets fell from 62.6 to 61.4; this ratio has steadily fallen from 88 per cent. in 1913. It is noteworthy that 39 municipalities were free of debt at the end of the year, while 24 others were expected to be clear by the end of 1925.

During the year the Commission operated twenty water-power generating plants with an aggregate capacity of 799,445 h.p., and a steam plant of 20,000 h.p. The total output was 2,850,878,576 kWh, but in addition the Commission purchased 150,922,465 kWh from outside sources, making a grand total of 3,001,801,041 kWh for the year as against 2,842,416,705 kWh in 1923.

A great deal of information is given regarding the work carried out in and the operation of the various systems into which the undertaking is divided. The principal of these is the Niagara system, whose three developments—the Queenston, "Ontario Power," and "Toronto Power" plants—produced no less than 2,526,662,700 kWh of the total output during the year. In May, 1924, the sixth unit, developing 62,000 h.p., was put on load at the Queenston plant and work proceeded on the installation of four more large generating sets. This work involved considerable rock excavation and placing of concrete, and the installation of penstocks, Johnson valves, turbines and other hydraulic equipment. The installation of the seventh set was practically completed and the eighth set was expected to be ready early in 1925, and the ninth in September next. When these sets are in operation the station will have a capacity of 500,000 h.p. The new plant has involved a great amount of new transmission line and equipment. Heavy steel-tower lines which were under construction in 1923 were completed and put into service during the early part of the year; these will deal with the power generated by the new sets. The Commission had in service at the end of the period 3,616 miles of transmission lines, including about 630 miles of 110,000-V conductors. The bulk of this is of plain or steel-reinforced aluminium, and the Niagara system includes the greater part of the mileage. In the Ontario Power Company generating station, the No. 15 unit was rebuilt. This was a 25,000-kW set, the generator of which burst in 1922 causing considerable damage. Two other generators were re-wound during the year. The machines in the Toronto Power Company generating station were equipped with differential relay protection and the No. 11 generator was partly re-wound. In Toronto two new high-pressure sub-stations were completed and placed in operation in October last. These are of the outdoor type, each having a capacity of 30,000 kVA. Seven other sub-stations were placed in operation during the year and the equipment at eleven stations was augmented.

Since the last report the Severn, Eugenia and Wasdells systems have been combined and are now known as the Georgian Bay system. The separate plants are so interconnected that they can be loaded so as to best conserve water for the good of the whole system. In the first month of the year there was a water shortage, but the heavy demand for power was met by outside purchases. The capacity of the Eugenia plant was increased by 1,200 h.p. in May, 1924, a second pipe line and surge tank having been installed. Maintenance work only was carried out in the Severn and Wasdells divisions. A commencement was made upon the extension of the South Falls development which is to raise the output from 1,700 to 5,400 h.p.

The load on the Muskoka system was so near the limit as to preclude the shutting down of plant for overhaul during the year. Power was purchased from Bracebridge to enable the system to cope with the demand. The completion of the South Falls extension will enable both of the generating sets to be shut down and overhauled in turn.

The demand on the St. Lawrence system was lightened by the loss of a large industrial consumer, and the Rideau system load showed no material increase owing to the quiet industrial conditions prevailing in the district.

The Cameron Falls generating station in the Thunder Bay system completed its fourth year of operation with a steadily-increasing load. Two new sets, each of 12,500 h.p., were placed in commission during the year, and the new transmission line was brought into use. The development assisted the Kaministiquia Power Company by supply power during the first half of 1924. The addition of the Great Lakes Paper Company to the system gives an extra load of 10,000 h.p. and brings the total up to about 40,000 h.p. Arrangements have been made for the installation of the fifth and sixth generating units at Cameron Falls, and it was expected that they would be ready for service by the end of 1925.

In the report on the Ottawa system special mention is made of the growth of the domestic load which makes a steadily-increasing demand upon the generating plant.

Important generating stations and lines have been added to the Central Ontario and Trent system. A new automatic generating station commenced to deliver power to the system in September, 1924. This three-unit station is equipped with relays which make its operation entirely automatic if desired, but it is intended to operate normally under the control of the operator of the Ranney Falls plant, which is about four miles upstream, through the medium of remote supervisory control equipment. By pressing a button, the operator can bring a unit on the line and have it delivering power in from 15 to 20 seconds. The generator switches close, bringing the generator on the line at approximately synchronous speed, with field short-circuited, but almost instantly afterwards the short-circuit is removed, the field switch is closed and the generator pulls into step. If desired, all three units may be started or stopped simultaneously. A similar automatic plant is under construction at a lower dam, and this concentration of so much power in the neighbourhood of Campbellford has necessitated the construction of additional 44,000-V lines to ensure the delivery of power to the system, and also to ensure the uninterrupted flow of water from plant to plant, which would be seriously upset for a time if any one plant in the Campbellford chain were to be cut away from the system. A new municipal receiving station was opened at Peterboro during the year. Following a dry summer and early autumn in 1923, there was a moderately good precipitation during November and December, and this proved sufficient for the power requirements owing to the industrial depression and absence of system load growth.

The power shortage on the Nipissing system was relieved by the placing in service of the first 600-h.p. set at the Bing-

* See ELEC. REV., July 4th, 1924, p. 19.

ham Chute power house in December, 1923; a second, similar, set was put into operation on March 31st, 1924. At the Nipissing plant one of the turbines was remodelled and the 450-kVA generator was replaced by one of 1,250 kVA. The inadequate wood pipe line reached the end of its useful life and was replaced by one of a larger capacity. An emergency Diesel-engine station has been erected at North Bay, but at the date of the report had not been required for service. The increase in the generating capacity of the system was accompanied by a large increase in load—an increase of 37 per cent.

During the year under review the Rural Hydro-Electric Distribution Act was amended to provide for including transformers and secondary equipment in the grant of the Provincial Government to help meet the disparity between the cost of urban and rural services, the amount of this grant to remain the same as when applied to primary lines only, *viz.*, up to 50 per cent. of the cost. The assistance thus given by the Government makes it possible to extend the service, and its beneficial influence upon agriculture and upon the general economic life of the province is already a factor of importance and worth. The minimum of three farm contracts per mile of line constructed, or the equivalent, is still the standard requested by the Commission as the basis of the application for the grant towards rural lines. During the year 285 miles of primary line was constructed, rehabilitated and absorbed, of which 38 miles was underground, and arrangements were made to construct a large number of additional rural lines during the current year. The capital cost of the latter was put at $321,103. At the date of the report 7,881 h.p. was being distributed in various rural districts, the bulk of it in the Niagara system. Special propaganda work dealing with the merits of electricity in farming has been undertaken by the Commission.

A great deal of testing, research, and inspection was carried out in the Commission's laboratories during the year. One of the special features of the work of the high-pressure and general electrical testing laboratory was the making of klydonograph* records in the detection of over-voltage surges on power lines. In the approval laboratory heating appliances formed the largest group submitted, wiring devices being the next largest, with motor-operated appliances very closely behind in point of numbers. A great deal of auxiliary radio equipment—battery charging sets, lightning arresters, &c., was submitted. The work of the photometric laboratory consisted mainly of maintaining the quality of the incandescent lamps which are made under the auspices of the Commission.

A section of the report deals with the street railways operated by the Commission. This shows that the Essex system progressed satisfactorily, but the revenue earned by the Guelph District and the Toronto and York District railways declined owing to the industrial depression in those areas.

The detailed accounts and statistics of the municipalities connected to the systems occupy over 370 pages, and there are appendixes containing statistics of transmission lines, transforming station details, distribution lines and systems, and reprints of Acts affecting the Commission passed during the year. The volume is illustrated with 36 views of various parts of the undertaking and 25 diagrams.

The Safety-in-Mines Research Board.

A Review of the Annual Report's Electrical Features.

THE third annual report of the above-named Board (H.M. Stationery Office, price 1s. net) opens with an account of the scheme of co-operation which has been settled with the United States Bureau of Mines, the object of which is to co-ordinate the researches into problems of safety and health and to secure mutual assistance between the investigators of the two countries. The scheme has been worked out in official visits paid to this country by Dr. Foster Bain and Mr. G. S. Rice, director and chief mining engineer respectively of the Bureau of Mines, and to the United States by Dr. R. V. Wheeler, director of the Board's experimental stations, who was joined by Mr. H. Walker, H.M. chief inspector of mines.

The first combined publication has already appeared [Chemical Society, Trans. 125 (September, 1924), 1858], Dr. S. C. Lind, chief chemist of the Bureau of Mines at Washington, contributing an addendum to a paper by Dr. Wheeler on the electrical ignition of gases. Amongst the investigations that Dr. Wheeler saw during his visit were the X-ray examination of wire ropes and "wireless" underground signalling at the General Electric Co.'s research laboratories, while at the works of the Edison Co. at Newark the manufacture of the Edison alkaline-battery safety lamp, and the safety devices incorporated therein, was inspected.

The report shows that the funds expended by the Board during the twelve months commencing April 1st, 1924, included the following:—For general purposes, including the use of electricity in coal mines, £27,900; for research regarding the safe use of explosives and electrical shot-firing apparatus, £11,000, the total sum amounting to £48,400.

The second part of the report deals with the steps that have been taken to replace the Eskmeals experimental station. Accommodation for the large-scale experiments has been secured at a site on The Frith, by Harpurhill, two miles from Buxton, and laboratory work is now being carried out at Sheffield in temporary premises, but the University has offered a lease of an excellent site adjoining the University buildings and plans of new laboratories are being prepared.

The subject of the main part of the report is the progress of the Board's researches. A list of the programmes of research, numbering a hundred, is given in an appendix. The programmes are divided into ten groups, which include flame-proof mining electrical machinery, electrical researches, electrical shot-firing apparatus, devices for trapping dust generated by drills, and safety lamps. In the case of those programmes, numbering over 60, which have been selected as the most urgent, the investigators in charge give in brief statements of what they have done and are doing; for instance, numerous experiments with various makes of bulbs show that the whole range of explosive mixtures of firedamp and air can be ignited by heated wires (Mr. W. C. F. Shepherd). It is, therefore, essential to obtain some knowledge of the fundamental factors governing the ignition of explosive gaseous mixtures by heated filaments. To avoid complications due to oxidation of the metal filament, the research was begun with platinum wire as the source of ignition, and a number of factors which play an important part in ignition have been studied. A general conclusion to be drawn from the research, so far as it has gone, is that the same temperature of platinum wire is required to ignite all explosive mixtures of firedamp and air; there is no differentiation between one mixture and another as with other sources of ignition.

As regards the propagation of flame (Mr. W. R. Chapman) the effect of turbulence produced by mechanical agitation forms part of an investigation regarding the construction of explosion-proof casings for electrical machinery. The simplest conditions under which gaseous explosions in closed vessels can be produced (central ignition in a sphere) have been dealt with in paper No. 5, "Flame-proof electrical apparatus for use in coal mines. First report—Flange protection," by Messrs. I. C. F. Statham and R. V. Wheeler (H.M. Stationery Office, September, 1924, price 1s. 3d. net). The shape of the enclosure, however, modifies the manner in which the flame spreads, and in consequence affects the development of pressure. Work has therefore been continued, using cylindrical vessels of different sizes, whilst the effect of turbulence in a spherical vessel has also been investigated. Of a more empirical nature, but of more immediate practical value, is a series of tests designed to provide flame-proof means of pressure-release from mining switchgear, alternative or supplementary to the method of release at a narrow gap between flanges. With the larger enclosures the extent of flange may not be sufficient to allow, through the width of gap permissible, all the release of pressure desired. The device which has been studied most closely embodies perforated metal plates. A specification with respect to the thickness and area of the plate and the diameter and spacing of the perforations has been worked out and a report on it will be published shortly.

From the records obtained (by means of a revolving drum camera) in connection with the propagation of flame in closed vessels (Mr. W. A. Kirkby) it has been observed that the flame has a vibratory movement both in the initial and final stages of inflammation. The speed of the flame varies considerably during the different stages of the inflammation, reaching 70 metres per second in certain experiments. It appears that the time of attainment of maximum pressure coincides with that of complete inflammation of the mixture in the vessel; the greatest pressure recorded in the vessel in use is 70 lb. per sq. in. The explosions are more violent in turbulent mixtures, both as regards the pressure rise and the speed of the flame. In conjunction with the British Electrical and Allied Industries Research Association, a considerable amount of information has been acquired bearing upon the construction of flame-proof casings for mining electrical machinery. Further investigations include a study of the effects of turbulence, such as might be produced in a motor casing or slip-ring cover, and also an inquiry into the effect of pressure piling, such as might occur in a partially partitioned switch case.

Reference may also be made to a research carried out by Mr. G. Lindley, the investigator appointed by the British Electrical and Allied Industries Research Association, on the construction of flame-proof plug and socket electrical contacts, which is nearing completion. The electrical work upon which most progress has been made is that dealing with the pressures produced in closed vessels when an arc is struck, a necessary corollary to research upon the pressures produced by explosions of firedamp and air in closed vessels, for in the design of mining switchgear it is necessary to take into account both

*The klydonograph and its use were dealt with in our issue of May 9th, 1924 (p. 770).

pressure effects. So far no pressures of any magnitude, due to the arc alone, have been recorded; the experiments are being continued, using greater power.

Regarding shot-firing apparatus (Mr. W. F. Crewdson), the part under consideration at present is the current necessary to cause ignition of firedamp-air mixtures, such as may enter a switch casing, by the "break" spark produced when an inductive circuit is broken by the separation of metallic contacts. The ease of ignition depends, among other things, upon the rate of separation of the contacts, the inductance in the circuit, the nature of the contacts, and the percentage of firedamp in the mixture. A question has arisen as to the advisability of substituting alternating for direct current when practicable, on account of its alleged greater safety. Comparisons are being made of the relative igniting powers of alternating and d.c. break-sparks as a check upon this claim.

The Sub-Committee for Research on Electrical Shot-firing Apparatus has completed its programme and its report is in preparation; it is able to make suggestions for the improvement of the mechanical efficiency of the magneto exploders at present in use so as to remove a fruitful cause of misfires, which is the chief fault of these exploders. With the present types, if the handle is turned improperly a weak current may be developed which will not fire the detonator, but will cause a chemical change in the priming composition—the operative part of the detonator—and this chemical change makes it more difficult to fire the detonator subsequently and may even result in a misfire.

The Miners' Lamps Committee presented its final report during 1924, thus bringing to an end five years of fruitful work towards the improvement of safety lamp design and practice. It reviews in detail the official requirements with regard to the testing of safety lamps and discusses possible lines of further developments in design and construction.

The remainder of the Board's report is occupied by statements of the work done by the independent investigators, who are aided by grants made on the recommendation of the Board, and by an account contributed by Dr. J. S. Haldane of the health inquiries carried on under the supervision of the Health Advisory Committee.

Mr. A. G. Gulliford, head lampman at Denaby and Cadeby Collieries, Rotherham, has again been assisted with a grant of £120 for the year to continue his experiments, under Dr. Wheeler's supervision, on firedamp detectors for electric lamps. This grant is solely for apparatus, materials and out-of-pocket expenses in connection with the work, which is done at home in spare time. Mr. Gulliford has completed the design of one form of firedamp indicator for attachment to an electric hand-lamp, namely, one which will enable the miner to find out whether the atmosphere in which he is working contains more than 2½ per cent. of firedamp. The device is a simple one, consisting merely of an exposed fuse-wire (suitably protected by gauzes) which can be put in series with the lamp bulb by means of a switch. If the atmosphere is clear of firedamp, the light of the lamp-bulb is dimmed when the fuse-wire is thrown into circuit and the wire itself glows a dull red. The more firedamp there is present, the dimmer does the light of the lamp become and the more brightly does the fuse-wire glow until, when there is 2½ per cent. of firedamp, the fuse-wire melts and the lamp-bulb is extinguished. The miner can recover his light by operating the switch.

As the result of many experiments, using different metals for the fuse-wire, it is clear that platinum is the most suitable. The small quantity of platinum used makes its cost infinitesimal, but it can, if desired, be recovered without loss when the fuse is renewed. Mr. Gulliford has designed the mode of attachment of the device to three different types of approved electric hand-lamps. In each instance the design is neat and the weight of the lamp is not materially increased. Future work will attempt to enable an exact measure to be made of percentages of firedamp between 1 and 5.

Plastic Moulding.

A Recent English Manufacture.

UNTIL recent years the art of plastic moulding was comparatively little known in this country, though the United States has for some few years taken up this class of work strongly. For this type of moulding the materials that have made the most progress are phenolic condensation products. These products are the result of a chemical re-action between phenol or carbolic acid and formaldehyde, the result being a unique synthetic chemical product resembling the finer or natural gums during one stage of manufacture.

Mouldensite, Limited, of Derbyshire, began to manufacture a product of this nature in 1922, by which success was attained at the outset and with the growth of "wireless" the demand for the product developed rapidly. The "Mouldensite" moulding powder, which is prepared in black and brown forms of granular consistence, is now extensively used by the principal manufacturers of electrical equipment calling for a material possessing exceptionally high dielectric and mechanical strength, and as the insulation is usually in an exposed position the moulded work must present a fine polished surface which shall be unaffected by oils, water, petrol, &c. When the "Mouldensite" moulding preparation is heated it fluxes, pressure at from about 500 to 2,500 lb. per sq. in. is applied to it in this state of flux and the material is forced to every part of the mould; the pressure within the mould is hydrostatic, or nearly so. Owing to the almost liquid condition of the material when in this state of flux, a thin film of the substance is formed next to the surface of the mould, and it is in part due to this that the form of the surface of the mould is reproduced with exactness, and with a very high finish. Whilst the first effect of the heat used in moulding is to soften or flux, at the same time it induces a chemical reaction. This causes the material to harden more or less quickly according to the size of the piece being moulded and the temperature used. When this reaction has been completed by the mould having been a sufficient length of time under heat, the work is finished. The moulded article cannot again be softened or fluxed by heat.

Time and temperature play an important part in moulding "Mouldensite," and are important elements in the determination of cost of moulding and moulding equipment. Metal inserts can readily be incorporated. They are "anchored" in the mould to prevent movement whilst the charge is being pressed, during which time the charge is moving or flowing to conform to the mould.

The charge of the powder is slightly in excess of the weight of the finished piece, so that when the mould is closed and the charge is put under pressure, the excess is extruded from the mould. This excess is very small when moulds are properly made, and is easily removed in the form of a "flash." It can be moulded with a high degree of accuracy.

The moulds are made of steel and hardened, the working surfaces being highly finished and polished. Moulds made of brass or bronze quickly distort under the pressure of moulding, and are not satisfactory. The contraction usually allowed is 3 mils per lineal inch. The moulds must be strong to withstand the pressure used, but contain as little metal as is consistent with these requirements in order to ensure the rapid conduction of heat.

It is interesting to note that the "Mouldensite" materials will apparently flow up before they flow down, and in certain deep wall pieces in which difficulty is experienced in moulding, it is found that by turning the mould upside down, a perfect piece can be obtained.

It is claimed that these mouldings can be turned out with accuracy and precision of finish greater than anything possible in the way of high class machine tool work produced by the most expensive automatic machine tools. Needless to say the hydraulic presses required to produce the mouldings are a much less expensive proposition, both with regard to initial outlay and also upkeep and operation charges, than the class of machine tool which would be required to turn out similar work.

It is claimed that Mouldensite is anhydrous and non-hygroscopic, has extremely high dielectric resistance, is very hard, retaining its finish indefinitely, is unaffected by temperatures below those at which carbonisation begins, has great mechanical strength in tension, compression and shear, whilst it may be moulded with all kinds of metal inserts, which it will not discolour, even though they be of silver or similar metals, as being a stable product it cannot break down chemically setting up free gases or other substances of a corrosive nature. It is homogeneous throughout and holds its colour indefinitely. Whilst it can be readily machined, filed or sawn, and takes a high lasting polish when buffed, it is only in rare instances that these processes have to be resorted to, it being generally found that all such requirements can be provided for in the moulding process.

The specific gravity of Mouldensite being only 1.33 or approximately half that of aluminium, it will be seen that the material is extremely light, yet at the same time, it is in no way brittle and will withstand considerable shock. The moulds differ from those used for the moulding of hard rubber, celluloid, &c., and in this connection Mouldensite, Limited, has a service which includes free mould-design for the benefit of its customers. At the present time, the firm in question is making a point of the fact that its product is British and claiming that it can compete for both quality and price with any similar product manufactured abroad, and also urging buyers in this country to consider the national aspect when purchasing moulding powders or mouldings.

We have seen a number of mouldings made from this material, and the manner in which the impression of the mould has been retained with microscopic sharpness as well as the beauty of finish is very satisfactory.

Drought Curtailment of Hydro-Electric Power.—Continuing drought in the Mountain States, and especially in Colorado, says the *Electrical World*, has curtailed the production of energy at a number of municipally owned hydro-electric plants, notably Longmont and Loveland, and standby service has been required on several occasions. In the northern Colorado district the sugar-beet and vegetable crops are approximately one-third of normal, and the only farms successfully overcoming the effects of the dry spell are those with electrically operated pumps. The major portion of the privately owned power stations' daytime load is reported as being used for pumping.

New Electrical Devices, Fittings and Plant.

(Readers are invited to submit particulars of new or improved devices and apparatus.)

A New Electrical Immersion Heater.

A new electrical immersion heater which has been placed on the market by MR. HAROLD E. TRENT, 259, North Lawrence Street, Philadelphia, Pa., is described in the *American Machinist*. It has been designed to meet the conditions necessary for the melting of salts such as lavite. The heating element is of the embedded type, packed in a steel tube to maintain a maximum of heat capacity. Its temperature may be

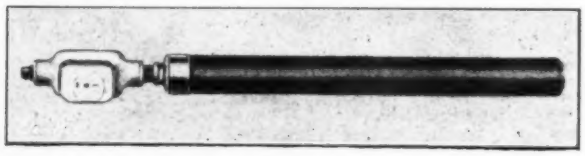


Fig. 1.—Immersion Heater.

raised to 1,600 deg. F. before the initial heating of the salt takes place. It is made in sizes up to 1,500 W capacity and 18 in. in length with a uniform diameter of 1.9 in. For the melting of other materials the loading may be increased, but care should be taken, as the salts under consideration are heat insulators and the thermo-capacity of the unit is limited. The plug connection on the end (fig. 1) can be supplied to suit.

A New Cable Connector.

Described in the *Electrical World* is a new cable connector, fig. 2, developed by M. FAURIS, Lyons, France, by which it is claimed that connection may be established between cables of any cross section in making a tap on a branch feeder without cutting the feeder. The upper portion can be removed by unscrewing the lower nut, and connection and disconnection is rendered simple by means of a wrench. The device is manufactured in different sizes.

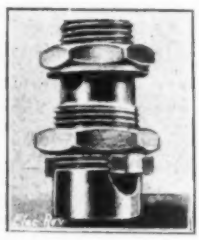


Fig. 2.—Cable Connector.

An Improved Arc-Welding Set.

The photographic reproduction herewith, fig. 3, is of a 6-kW electric arc-welding set marketed by MESSRS. THE QUASI-ARC CO., LTD., 15, Grosvenor Gardens, London, S.W., who have adopted as the driving unit a 10-h.p. 4-cylinder marine-type petrol motor, made by Messrs. J. W. Brooke & Co., Ltd., Adrian Works, Lowestoft, driving direct by means of a flexible coupling. The generator is designed to give a 60/30 volt-

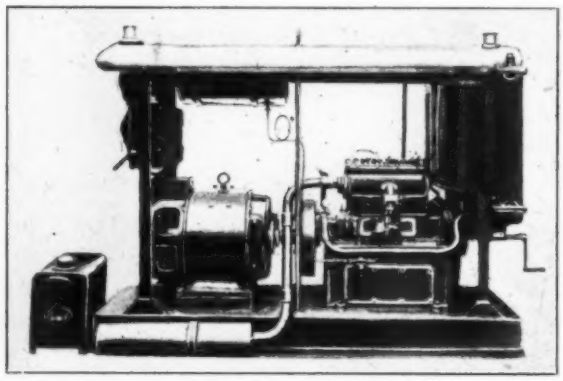


Fig. 3.—A 6-kW Arc-Welding Plant.

drop characteristic, the lower pressure corresponding to a full load of 200 A, and is used in conjunction with a special reactance and field reactor; the former supplies the momentary pressure rise, whilst the latter, it is claimed, renders the pressure change of the machine exceedingly rapid. The field reactor is claimed to give the machine greater efficiency than other types of drooping characteristic welding dynamos; it consists of a static transformer, the primary winding forming part of the welding circuit, and the secondary part of the shunt field circuit; any change of current in the primary induces an e.m.f. in the secondary which is so connected as to accelerate the variation of current in the shunt field coils. A portable regulator is provided for effecting current regulation. An electromagnetic governor of the solenoid type controls the speed during the striking of the arc, after which period the duty is performed by a centrifugal type governor. The plant, including fuel tanks, radiator and cooling fan, is self-contained and the weight of the whole set does not exceed 18 cwt.

Electric Iron Indicator Plug.

We have received from Mr. W. T. HUGHES, 74, The Downs, Altrincham, Cheshire, particulars of a unique indicator-plug for use with electric irons. The indication is given by means of an ordinary 2.5-V lamp of the flash-lamp type. This lamp is shunted across a spiral resistance which is in series with the

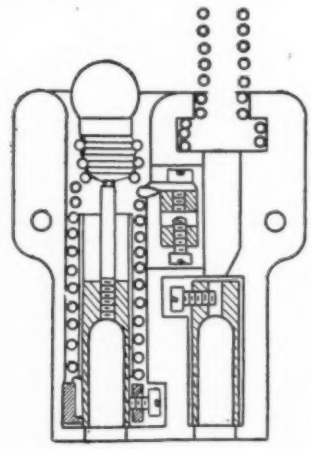


Fig. 4.—Section of Indicator-Plug.

element of the iron. The spiral resistance, which is designed to give a pressure drop of 1.8 V, also acts as a spring holder for the lamp. We understand that negotiations are at present taking place for the manufacture of this device, a sectional illustration of which is shown in fig. 4.

An Improved Windmill.

We illustrate herewith, fig. 5, the "Empire" windmill, which is made by MESSRS. CECIL HODGES & CO., LTD., Empire Works, Dalston, London. Its principle closely follows that of the old wooden windmills, and it consists essentially of from four to eight large wings. Each wing is divided into four panels which fit closely together and present a solid surface to the wind when it is blowing at a moderate rate, and which gradually and automatically open when the wind pressure gets

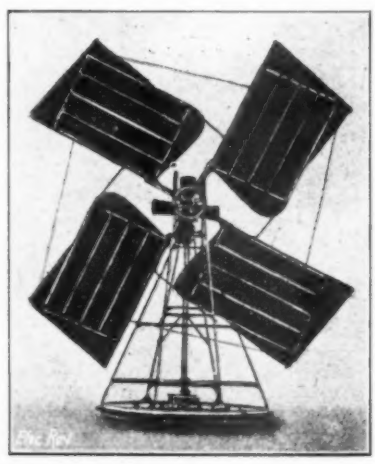


Fig. 5.—The "Empire" Patent Windmill.

beyond a certain strength, thereby maintaining a constant speed on the turbine and rendering it suitable as a means of driving electric generators. It is claimed that the mill can be operated in a wind of less than 5 m.p.h.

The machine is fitted with ball and roller bearings throughout. It should prove a success in the lighting by electricity of country houses, farms and villages, the winds being normally strongest in those periods when the lighting demand is greatest.

A Novel Electric Cooker.

The "Quead" Cooker.

CONTRARY to many prevalent opinions on the subject of cooking, an eminent London surgeon has expressed the view that "the flavour and digestibility of meat foods are impaired by prolonged cooking, owing to the coagulation by heat of the albumin which is the main constituent of all animal foods. The longer an egg is cooked, the harder it becomes and the longer it takes to digest, due to the stomach juices having to re-digest the coagulated albumin."

It may therefore be inferred that rapid cooking of short duration is desirable in that the external albuminous layers are thereby quickly coagulated, which allows the red internal juices to be retained in a semi-fluid and digestible condition. It is with such objects in view that the "Quead" cooker has been designed on novel lines for domestic use by Messrs. Wm. Geipel & Co., who have discarded the idea of roasting in hot air and gases confined in an oven which has been the vogue for so long. Moreover, the new cooker has been arranged to improve upon the customary method of grilling, which cooks the top side only, while the juices are oozing out at the bottom.

In the "Quead" cooker the source of heat is near the centre of the oven and consists of two vertically disposed elements adjustable horizontally so that they can be brought near to the meat for grilling, as shown in fig. 1, or moved apart for roasting, as indicated in fig. 2. The adjustment is made by means

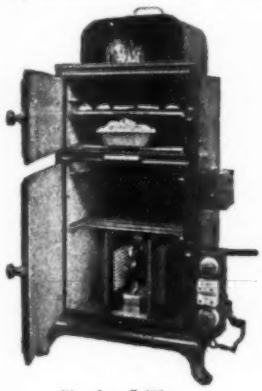


Fig. 1.—Grilling.

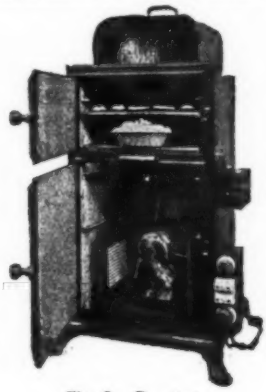


Fig. 2.—Roasting.

Interior of the "Quead" Cooker.

of a lever at the side, and the meat to be grilled is held vertically, as illustrated in fig. 1, in a removable rack similar to a bread toaster.

Being placed, so to speak, in a bath of radiant heat—a reversion to the old custom of roasting before an open fire—the meat is cooked remarkably quickly; the elements are thermally insulated from the metal inside of the cooker, and are consequently rapidly heated and ready for cooking in three minutes after switching them on. It is not necessary to have the walls of the cooker hot; in fact, simple grilling is sometimes completed before they are even warm, and the energy required to maintain the necessary temperature is therefore comparatively small. The economy in this respect, coupled with the reduced time occupied in cooking, which is about one-half of that ordinarily required, it is claimed, ensures a saving of as much as 75 per cent. in electricity for roasting.

For roasting, the joint is hung on a hook which is slowly rotated by means of a clockwork motor, while means are provided for arresting the motor at any desired point. This is useful for certain shapes of joints, such as a saddle of mutton, which, if continually rotated, is apt to be cooked more at the edges than in the middle.

A device for automatic basting is provided in the form of a cup for holding the fat, with a small tap for regulating the rate of basting. The cup is supported by a socket and lever which can be swung out of the cooker for filling, &c., and it allows a joint to be roasted without any attention other than reducing the heat after the first 10 minutes.

Two patterns are exhibited at the British Empire Exhibition: One consists of two compartments, each being 16 by 14 in. and provided with separate doors; the lower compartment is 21 in. high and contains the two 1,000-watt heating elements for roasting, grilling, frying, broiling, and boiling, and it can also be used for baking. The upper compartment, which is 9 in. high, is heated by waste heat assisted by a separate 500-watt element, and can be used for baking, warming, &c., at the same time as the lower one is being used. The other pattern is a smaller one of similar type.

A thermometer is fitted, if required, and above the upper compartment a plate warmer is provided with a hood that entirely surrounds the plates and ensures that the top plates are as hot as those at the bottom. Boiling plates of various sizes and types are supplied, according to requirement, and the usual 3-heat control has been adopted with switches of the new pattern for turning up and down by moving the handle in either direction. The cooker is mounted on a cast-iron base and frame; the sides, doors, and top are lagged, while the interior is lined with enamelled plates.

Correspondence.

***Correspondents should forward their communications* at the earliest possible moment.** *No letter can be published unless we have the writer's name and address in our possession.*

Retailers and the N.A.R.M.A.T.

I note in a copy of *The Radio Trade Journal* which has been forwarded to the Wireless Retailers' Association, the statement that "each section has a voice" in the administration of the N.A.R.M.A.T. The important point, however, is that the retailers have only *one-fourth* of the voting power, and can consequently be outvoted every time. In other words, the manufacturing interests control the situation. In these circumstances the picture which is drawn of peace and progress prevailing at a round-table conference of members is suggestive of the lion lying down with the lamb, the irony of which strikes a distinctly humorous note. From this it will be seen that before he accepts the small increases of discounts offered to him, the retailer has to consider not only whether he will have "risked financial loss by promising not to sell foreign goods," but whether he will be entering into binding restrictions and rendering himself liable to other restraints in the imposition of which he has no effective voice.

In conclusion, the trade is entitled to know why the N.A.R.M. has attempted to form a Retail Section when there was already a retailers' association of some two years' standing in existence, and why the Wireless Retailers' Association was not consulted on the matter. In short, if peace and goodwill were really desired, why was not co-operation sought with the existing organisation? The multiplying of organisations, the N.A.R.M. must know, can only have the effect of weakening the section so split up.

Fredk. S. Horsey,

Chairman of the Wireless Retailers' Association.

London, *August 15th*, 1925.

Modernising Electric Tramcars.

The manager of the London combine tramways, Mr. C. J. Spencer, is to be congratulated for introducing the very fine cars described in your issue of the 7th inst. I am confident that the innovation of cushioned cross seats will be decidedly welcomed by the public, so much so that other progressive undertakings will have to adopt similar seating accommodation in the near future.

The progress of British tramcar design has been, in the past, rather disappointing, and has not compared favourably with electric train and motor omnibus development. Modern 'buses with powerful equipment, comfortable seats, bright interiors, and pneumatic tires, undoubtedly have provided a very attractive service in contrast with the generality of provincial tramways whose cars are, apparently, considered by the management to be good enough for 1925 though designed 20 or 25 years ago. It is, therefore, not difficult to understand how a large body of the public has, under the influence of a misguided and irresponsible Press, come to regard tramway transit as obsolete and has shown complete willingness to patronise any 'bus venture in preference thereto.

The service given by the L.C.C. is, very probably, the best in the country, yet its latest cars, though fast and attractively finished, still provide no better seating accommodation than formerly. Having used the London transit facilities for some years, I am very much of the opinion that the L.C.C. would, with cars having cushioned cross seats, secure a greater measure of public support. The average British tramcar does not appear to be the equal of the American street car. Why is this? Are British conditions so widely different that we cannot employ more extensively the separate entrance and one-man car with, of course, cross seats and higher speeds?

Too often is it the case that improvements in service are made only under the stress of 'bus competition, and it is at least open to question whether tramway managements have not contributed to their troubles by their ultra-conservative policy in the past. Our tramway undertakings are, perhaps, open to most serious criticism in persistently retaining the longitudinal wooden seat in spite of a marked public preference for superior comfort, such as is afforded by most progressive 'bus services. The prevailing type of tramcar seat was discarded by 'buses and American cars some years ago, and it certainly does not appear to be well suited to modern cars, with high rates of acceleration and braking. The conventional seating arrangements are supposed to facilitate the movement of passengers, but this has not prevented American systems from adopting the transverse seat.

Closely affecting the comfort of the passenger is the design of the undercarriage. On some of our largest systems the cars "jazz" and pitch in a most disagreeable and, in many cases, alarming manner. The jarring and bouncing whilst in motion, together with the din set up in negotiating crossings, suggest that a reconsideration of the conventional design would not be unprofitable. Even the illumination is often carried out on entirely incorrect principles, and reference has often been made to the extensive use of the unshaded filament by large traction systems. With low ceilings and large lighting units the result is decidedly unpleasant.

If I may venture an opinion it is that a more progressive policy is badly needed in the British tramway industry generally with regard to car design. Much improvement could be effected in the comfort and running of existing cars without appreciably increasing the operating cost. The important improvements in tramcar construction, in speed, comfort, lighting, &c., effected by Mr. C. J. Spencer are, therefore, of particular interest and value.

H. A. W.

Glasgow, *August 11th*, 1925.

A Proposed Institute of Radio Engineers.

On reading the statement of the I.E.E., in your issue of August 7th, it appears that the Wireless Section will be quite a subsidiary part of the Institution and would possibly be neglected when interests might clash.

In view of the enormous advance in wireless engineering during the past few years, and the certainty of further expansion, a separate Institute, to safeguard the interests of radio engineers, would certainly appear advisable.

With regard to the subjects for examination, these appear excellent, but there might be a tendency to set such papers chiefly from the electrical engineer's standpoint, and not from that of the purely radio engineer.

J. H. Tanton.

Halton, Bucks., *August 10th*, 1925.

Charges for Electricity Supply.

I have recently received two accounts from the Manchester Corporation for the last quarter's consumption of gas and electricity (lighting).

I was rather surprised to observe that although my consumption of "juice" for the quarter was only *twelve units* I am charged the amount of *ten shillings* (10s.). This amount is put under the heading "Minimum Charge." I presume from this that I am asked to pay £2 per annum whether I consume this amount or not. I understand that if the consumption exceeds this amount there will be a rebate. I may say that this is the second quarter's account as far as I am concerned, and it seems to me that the electricity department has the loan of my 4s. 6d. until the end of the year, notwithstanding that a deposit of £1 was paid before the installation was connected.

The gas department makes no mention of "Minimum Charge," and charges for B.th.u. consumed. Further, it offers a discount if the account is paid before a certain date, a feature which the electricity department omits. The gas department will install a cooker free of charge—the electricity department at a charge of 7s. 6d. per quarter. The rate for supply (power and lighting) under the electricity department (Norwich system) is in my case 11s. 8d. per quarter, plus ½d. per unit consumed, making a standing charge of 19s. per quarter—rather a stiff charge for the so-called convenience, cleanliness, &c., is it not?

I can well understand my non-technical friend's resentment at having to pay this minimum charge for lighting, and I myself feel it is not justified. The hire charges and rates for cookers make these articles a luxury which very few people can afford.

In view of the exhortation to use electricity and the knowledge that neighbouring towns make lower charges, it is very disappointing to find such things in Manchester. In fact one is tempted to say: "Save me from my friends."

"Stung."

Manchester, *August 17th*, 1925.

Railway Electrification in the United States.—Some particulars concerning the progress made during 1924 in railway electrification are given in abstracts in the *Railway Review* from the report of the Committee of the American Railway Association, Division V—Mechanical, on the subject of electric rolling stock. The activities in electrification were confined largely to adding rolling stock to existing projects, or the culmination of projects conceived previous to 1924. The development which is perhaps commanding the greatest interest is that wherein the sub-station plant is carried as part of the locomotive equipment. Under this heading are locomotives for the Detroit, Toledo, and Ironton and the New York, New Haven, and Hartford. The D.T. & I. project comprises a 25-cycle, 22,000-V, single-phase, a.c. distribution, with converting equipment on the locomotive to provide 600-V, d.c., for the traction motors. The transformers are so arranged that the locomotive can be operated from an 11,000-V supply. The New York, New Haven, and Hartford locomotives are designed to operate from the 25-cycle, single-phase, 11,000-V, a.c. trolley supply, which will be converted on the locomotive to d.c. An experimental oil-electrical locomotive was put into service on the New York Central, and tests indicate that it has great possibilities, particularly for switching and branch-line service. Anticipating the need for equipment to compete with the auto bus, as well as to reduce operating expense on branch lines, a considerable development has taken place during the year on gas-electric cars and small gas-electric locomotives. An experimental 3,000-V, d.c. multiple-unit car has been built primarily for terminal operation where the main line is 3,000 V d.c. trolley distribution.

Published Specifications.

Compiled expressly for this journal by Patent Agents.
The name of the applicant's patent agent, if any, will be found on the printed specification.
The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1924.

1,430. "Holder for crystal and necessary metallic contacts, used as a detector of electromagnetic radiation." L. Massey. January 18th, 1924. (237,299.)

1,876. "Electric relays." R. Haddan (J. B. Regan). January 23rd, 1924. (237,301.)

6,970. "Electric controllers of the liquid type." A. West & Co. and V. Breeze. March 18th, 1924. (237,317.)

7,277. "Instantaneous automatic governor for electrical machines." A. Junek. March 21st, 1923. (213,278.)

9,822. "Electric furnaces for melting and treating ores and metals generally." T. Levoz. April 17th, 1923. (214,648.)

9,981. "Alternating-current relays." British Thomson-Houston Co., Ltd., and A. S. Fitzgerald. April 22nd, 1924. (237,334.)

10,030. "Apparatus for varying the capacity of the resistance of an electric circuit." Aktiebolaget Baltic. October 25th, 1923. (223,859.)

10,083. "Receiving valves such as are used in connection with pneumatic ticket-carrier apparatus." Western Electric Co., Ltd., and G. M. O. Jenkins. April 23rd, 1924. (237,339.)

10,185. "Electric generator protector." T. W. Sampson and W. C. Chappell. May 2nd, 1923. (215,346.)

10,310. "Headlights of vehicles." J. Ayer. April 25th, 1924. (237,392.)

10,601. "Electric switchgear for variable resistances, particularly applicable to Leonard drives." P. C. Rushen (Siemens-Schuckertwerke Ges.). April 29th, 1924. (237,362.)

11,016. "Leads for headphones, telephones, and the like." J. W. Lyon. May 5th, 1924. (237,371.)

12,182. "Electric multiple-body comb for use all over the body." O. G. C. L. J. Overbeck. May 17th, 1924. (237,384.)

13,151. "Valve-holders for wireless apparatus." A. P. Portway. May 28th, 1924. (237,393.)

14,008. "Design of magnets and pole-shoes, as used in wireless headphones and the like." H. W. Bull, jun. June 10th, 1924. (237,402.)

14,223. "Telephone receivers and the like." J. Joseph and W. A. Appleton. June 12th, 1924. (237,404.)

15,426. "Holders for thermionic valves and the like." H. W. Goss and H. D. Murray. June 26th, 1924. (237,414.)

17,714. "Electric cables." C. Vernier. July 24th, 1924. (237,427.)

18,267. "Electric flash-light or torch." H. W. Jones. July 31st, 1924. (237,431.)

19,418. "Device on prepayment meters for charging at different rates for energy consumed." Landis & Gyr Soc. Anon. August 16th, 1923. (220,648.)

19,646. "Distributors for electric ignition systems." T. Dooley and P. Forrester. August 19th, 1924. (237,439.)

19,812. "Battery lamps for continuous lighting, especially cycle lamps, watchmen's lamps, and the like." W. Botz. April 10th, 1924. (232,156.)

21,291. "Selector switches." Western Electric Co., Ltd. (Western Electric Co. Inc.). September 9th, 1924. (237,447.)

22,164. "Balancing arrangements for use in telephonic and like connections." Siemens & Halske Akt. Ges. October 6th, 1923. (222,852.)

22,245. "Electric metal melting furnace." Hirsch Kupfer und Messingwerke Akt. Ges. September 20th, 1923. (222,145.)

22,472. "Electric signalling apparatus." W. B. Dale, R. A. Hopkinson, and J. Hopkinson & Co., Ltd. September 23rd, 1924. (237,456.)

23,102. "Spool for coils in electrical apparatus." Landis & Gyr Soc. Anon. October 9th, 1923. (223,219.)

24,888. "Electric condensers." A. E. Alexander (U.S. Tool Co. Inc.). October 20th, 1924. (237,466.)

25,211. "Pendant for supporting light bowls, such as are used beneath electric lights and the like." R. I. Scorer. October 23rd, 1924. (237,467.)

25,461. "Electric pumps." Dr. A. Nagel. December 5th, 1923. (225,829.)

25,557. "Radio frequency transformers." Dubilier Condenser Co., Ltd. (formerly Dubilier Condenser Co. (1921), Ltd.) (H. W. Houck). October 27th, 1924. (237,469.)

25,899. "Protective devices for direct-current systems." Metropolitan-Vickers Electrical Co., Ltd. November 5th, 1923. (224,526.)

26,074. "High-frequency telephone systems employing overhead power conductors." Telefunken Ges. fur Drahtlose Telegraphie. November 2nd, 1923. (224,247.)

26,110. "Wireless crystal detectors." S. E. Hall, J. H. Hall, and H. H. Ratcliff. November 3rd, 1924. (237,471.)

27,022. "Mercury-treadle electric switches used on railways." Siemens Bros. & Co., Ltd., and L. De M. G. Ferreira. November 12th, 1924. (237,473.

27,121. "Electron discharge devices." British Thomson-Houston Co., Ltd. November 13th, 1923. (224,906.)

27,482. "Loud-speaking telephonic apparatus." E. A. Graham. November 17th, 1924. (237,477.)

29,675. "Electric heater for fluids, gases, vapours, and the like." O. Neiss. December 10th, 1923. (226,207.)

31,046. "Railway and tramway switch-boxes or ground levers." S. S. Wrightson and C. R. Matthews. December 29th, 1924. (237,497.)

1925.

1,073. "Electrical control devices for electromagnetically operated elements acting on objects." C. S. Dutton and G. H. Derrick. January 13th, 1925. (237,503.)

1,189. "Dynamo-electric machines." British Thomson-Houston Co., Ltd. January 14th, 1924. (227,845.)

1,611. "Vacuum-tube oscillation-generators for wireless transmission." Westinghouse Electric & Manufacturing Co. January 22nd, 1924. (228,159.)

2,092. "Short-circuiting devices for three-phase induction motors." Deutsche Werke Akt. Ges. January 24th, 1924. (228,181.)

2,869. "Electrical and thermal insulating material." N. Stabile. February 2nd, 1925. (237,507.)

4,121. "Machines for forming pigtails and inserting them into glass rods of incandescent lamps or similar devices." Naamloore Vennootschap Philips Gloeilampenfabrieken. March 6th, 1924. (230,431.)

4,769. "Head-bands for carrying telephone receivers." J. A. Ross and T. Taylor. February 20th, 1925. (237,514.)

5,118. "Incandescent cathodes for discharge tubes." Siemens & Halske Akt. Ges. February 26th, 1924. (230,066.)

6,688. "Electric lamps." J. Zelisko. March 11th, 1924. (230,836.)

7,993. "Electromagnetic sound-reproducers." Brandes, Ltd., and W. A. Bartlett. March 25th, 1925. (237,531.)

9,716. "Mercury vapour rectifiers." Akt. Ges. Brown, Boveri et Cie. April 10th, 1924. (232,260.)

10,381. "Machines for making incandescent electric lamps and similar articles." British Thomson-Houston Co., Ltd. April 22nd, 1924. (232,953.)

10,806. "Pantograph collectors for electric vehicles." Metropolitan-Vickers Electrical Co., Ltd. April 25th, 1924. (232,985.)

13,169. "Coupling device for combined electric starters and dynamos for automobile engines." Soc. Anon. pour l'Equipement Electrique des Véhicules. September 15th, 1924. (237,541.)